

CHAPTER VI

EMERGENCY ACTION PLANS

NOVEMBER 1998

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Chapter VI

EMERGENCY ACTION PLANS

6-1 PURPOSE AND SCOPE

6-1.1 Purpose

As required by Section 12.20 (a) of the Commission's Regulations, every applicant for license or licensee/exemptee must develop and file an EAP with the Regional Director unless granted a written exemption in accordance with Section 12.21 (a) of the Regulations.

The purpose of this chapter of the Federal Energy Regulatory Commission's Engineering Guidelines is three-fold. First, recommended procedures and criteria are provided for performing or reviewing the analytical studies required for an EAP. Second, a format is provided for preparing an EAP document in a manner consistent with Federal guidance. Third, information is provided on the basic requirements for conducting comprehensive exercises for testing an Emergency Action Plan (EAP). These Guidelines provide a basis to develop and maintain an effective EAP. Since every EAP is unique, individual project features and downstream effects will govern the content of the plan. The goal is to develop the best EAP possible.

6-1.2 Background

The "Guidelines for Preparation of Emergency Action Plans" were established in November 1979. The Guidelines were subsequently included as the Appendix to Order No. 122 of the Commission's Regulations, issued January 21, 1981. Then, in accordance with the provisions of Section 12.22 (a) (1) of the Commission's regulations, which states that "an emergency action plan must conform with the Guidelines established, and from time to time revised, ...", the guidelines were revised on April 5, 1985, to provide more specific comprehensive guidance in the development of an EAP. Although the revised Guidelines established a specific format to assist in preparing an effective, workable EAP, it was not mandatory at that time that EAPs on file prior to April 5, 1985, comply with this format.

The EAP Guidelines were further revised on February 22, 1988, to provide a more workable EAP that included a notification flowchart located at the front of the EAP and more clear, concise, easy-to-read inundation maps depicting the dam break scenario. In addition, a need existed for a periodic reprinting and redistribution of the EAP to improve this aspect of its dam safety program.

Since that time, an initiative was developed to provide national (Federal, State, local) consistency in the content of Emergency Action Plans at dams throughout the country. As a result, the *ad hoc*

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Interagency Committee on Dam Safety (ICODS) prepared and approved federal guidelines for emergency action planning at dams which was published by FEMA in October 1998. As a result of the federal initiative, the FERC EAP Guidelines are further revised.

6-1.3 Scope

The FERC EAP Guidelines (Guidelines) establish a specific format to assist in preparing an effective, workable EAP. The format was developed to include all the pertinent information required for the EAP and accompanying appendices. In providing the appropriate information, the EAP should be site specific, reflecting mode of operation, internal and external means of communication, and interaction with appropriate agencies and owners of other sites. The format should be used in conjunction with the instructions contained in Part 12, Subpart C of the Commission's Regulations.

All EAPs, except for those at government dams, shall conform with the format and criteria established in these Guidelines. In order to ensure every EAP currently on file with the Regional Director complies with the established format, every EAP filed prior to the date of issuance of these Guidelines must be revised, as necessary, to conform with the format and then be completely redistributed to all participants, with three copies resubmitted to the Regional Director. Subsequently, a completely reprinted copy of the most up-to-date EAP must be redistributed to all participants, including three copies to the Regional Director, on a five year cycle (as a maximum). The licensee/exemptee/applicant for license has the option to place Appendix A of the Guidelines (Investigation and Analyses of Dambreak Floods) in a separate volume which only has to be provided to the Commission. This volume would need to be reprinted only when analyses are updated. All other sections of the EAP must be reprinted at least every five years. During the intervening years, the licensee must maintain a line of communication with all parties involved in their EAP. Regular exchanges of information will assure that the EAP remains current and workable during an emergency. Information concerning changes in organizations, personnel, phone numbers, emergency response responsibilities, or other site specific information should be exchanged on a regular basis. Once notified of a change that would affect the EAP, the licensee is required, within 30 days of the notification, make the necessary changes to the EAP and issue revised pages, sections, maps, as appropriate, to all parties identified in the EAP. If no interim changes are necessary, annual updates (which are to be submitted by December 31st of each year) may be made by issuing to all plan holders only those pages that contain updated information. Nevertheless, total reprintings of the EAP on more frequent basis are acceptable and commendable.

When the applicant for license is not the owner of the dam nor is otherwise responsible for the maintenance, operation and monitoring of the dam, the applicant for license should coordinate with the owner of the dam to develop an EAP. In the event that an owner refuses to cooperate, the applicant for license should prepare the EAP to the best of its ability with the information available to it and provide it to the owner. If the owner indicates that it will not implement the EAP in the event of an emergency, the applicant for license should provide a copy of the EAP to the State agency responsible

for dam safety and explain the situation to the agency. The applicant for license should also advise the Regional Director of the owner's lack of cooperation.

In the event of competing applications, if one of the applicants for license is the owner of the dam, it is that applicant's responsibility to develop an EAP. If none of the competing applicants is the owner of the dam, then it is the responsibility of the applicant first having its application on file to prepare the EAP.

Under the provisions of Section 12.22 (c) of the Commission's Regulations, each hydroelectric project under the jurisdiction of the Commission and located within a 10-mile radius of a nuclear power plant reactor must have a radiological emergency response plan to be implemented in the event of a severe accident or incident resulting in the release of radioactive materials from a nuclear plant. The guidelines for preparation of a radiological emergency response plan (Section 6-5, page 6-60) should be used in conjunction with the instructions contained in Section 12.22 (c) of the Commission's Regulations.

When a project is located at a Federal dam, a procedure for notifying the appropriate representatives of the Federal agency of an emergency condition must be available (Section 6-6, page 6-61). The EAP at a government dam must also include the requirement that the Commission's Regional Director be notified immediately of the occurrence of an emergency situation.

6-1.4 Changes to the Guidelines

The Guidelines have been modified to be consistent with the "Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners", Mitigation Directorate FEMA 64, October 1998 (6-3.3, page 6-12).

6-2 ANALYTICAL REQUIREMENTS

6-2.1 General

The analytical requirements for an EAP include the information necessary to conduct dambreak analyses and to prepare inundation maps. Since most of the engineering studies and requirements related to flood studies pertinent to an EAP are discussed in Chapter II of the Engineering Guidelines they will not be repeated in this Chapter. Therefore, out of necessity there will be frequent references to Chapter II of the Engineering Guidelines. Thus, the reader should also have a copy of Chapter II for reference.

The process of developing a workable EAP must necessarily begin with the knowledge of what areas will be flooded as a result of a dam failure, or unusually large spillway release, so that the jurisdictions and other agencies and individuals involved in the implementation of the EAP can be identified. The tools for identifying the areas flooded and developing the notification procedures are primarily dambreak analyses and inundation mapping. For EAP implementation, evacuation agencies will most likely refer to the inundation maps to identify evacuation zones in the event of an emergency.

6-2.2 Dambreak Analyses

Information that should be provided regarding the dambreak analyses that are necessary to determine the extent of inundation due to a dam failure should be included in Appendix A of the EAP document. The dambreak analyses should be reviewed by the Regional Office staff for acceptability. Appendix II-A of Chapter II of the Engineering Guidelines provides references and criteria which may prove useful as indicators of reasonableness for the breach parameter, peak discharge, depth of flow, and travel time determined by the licensee.

When large discrepancies in compared values exist or questions arise about assumptions, an independent dambreak sensitivity analysis should be performed by Regional Office staff. For these analyses, it is recommended that Regional Office staff use the dam break software package that utilizes the National Weather Service's (NWS) DAMBRK Program (or most recent program). If necessary, supplemental information should be requested from the licensee. Although the NWS Dambreak program is preferred, it is acceptable to use other widely accepted models.

Several different inflow conditions may need to be investigated to determine the appropriate condition prevailing at the time of a dam failure in order to ensure that the EAP includes all communities that need to be notified. A "fair weather" dam failure (reservoir at normal full pool elevation, normal stream flow prevailing) is generally considered to have the most potential for loss of human life, primarily due to the element of surprise. However, a failure of a dam during flood flow conditions will result in flooding downstream areas to higher elevations than during a "fair weather" failure. The result could be additional loss of human life that otherwise would not occur during a "fair weather" failure. In addition,

as discussed in Section 6-2.3 of this Chapter, experience has shown that the emergency preparedness agencies will use the inundation maps to develop their evacuation procedures. To assist the agencies, both the "fair weather" breach and a failure during a flood level approaching the inflow design flood (IDF) are typically analyzed to bracket the full extent of the area potentially impacted by a failure. **If inundated areas for the "fair weather" breach and the IDF breach are essentially the same or are too close to be shown separately on the inundation maps, then a single inundation area for the two breach conditions may be shown. Otherwise, both the "fair weather" breach and the flood flow breach should be clearly shown on the inundation map because response agencies depend on the maps to implement an evacuation and, therefore, need both dam failure boundaries shown on the maps.**

These two failure conditions will greatly assist emergency preparedness agencies in their evacuation responsibilities. Experience has shown that a failure during flood conditions can create special flooding problems requiring changes and/or additions to the notification procedures that are developed for a "fair weather" breach. If there is good reason not to include both boundaries, such as, the inundation boundaries are essentially the same or are too close to be shown separately, or the agencies do not want them on the maps, then only one boundary is necessary. (See discussion under inundation maps, Section 6-2.3.)

For the flood condition failure, as discussed in Chapter II of the Engineering Guidelines, the dam should be assumed to remain in place until the peak reservoir elevation for the assumed flood inflow condition is attained before the postulated dam breach occurs. It may also be necessary to conduct a sensitivity analysis of the breach parameters (i.e. varying the breach width and time to failure) for the various flood inflow conditions in order to investigate the impacts for a range of possible failure scenarios. The Regional Director may require, on a case-by-case basis, an investigation of other flood flow scenarios in addition to those selected by the licensee to ensure that all communities requiring evacuation by local officials have been identified. Pursuant to the Commission's Regulation (Part 12, Subpart D), most dams that require an inspection and evaluation by an independent consultant have already been investigated for the "fair weather" breach, as well as failure at the IDF. Therefore, most licensees have available the necessary information to show the inundation boundaries for the "fair weather" and IDF failure conditions.

Regardless of the flood condition analyzed, it should be remembered that the assumed flood condition is not the only factor affecting the results of a dambreak study. Computer models, breach assumptions, dam size and location, downstream terrain, map scales, and plotting of inundation boundaries inherently place limitations on the accuracy of an inundation study. Therefore, the licensee should provide a summary in Appendix A to the EAP of the possible limitations on the accuracy of the study (e.g. computer generated elevations are expected to be within a certain accuracy).

The need to consider the domino effect of multiple dams should be made on a case-by-case basis. If the assumed failure of a dam would cause the failure of any downstream dams, the licensee or dam

owner has the responsibility to consider the domino effect in its routing of the floodwave downstream. The flood wave should be routed to the point where it no longer presents a hazard to downstream life or property, which includes downstream dams. Therefore, the licensee, after assuming a hypothetical failure of its dam, should make an engineering judgment regarding the potential for failure of the downstream dams from the flow condition under consideration or as a result of the failure of the dam being investigated to determine whether it would be prudent to consider failure of any downstream dams during the routing of the dambreak flood wave. The licensee may coordinate with the FERC Regional Office staff to decide whether downstream dams should be considered to fail from the domino effect. Coordination of such studies with downstream dam owners should be undertaken by the licensees, where feasible. Of course, if the downstream dams are owned by the same licensee, this should not be a problem.

Appendix VI-A contains guidance for the selection of acceptable breach parameters.

6-2.3 Inundation Maps

The elevations and travel times resulting from the dambreak analyses that clearly indicate the potential hazard to downstream life and property should appear on an inundation map. Therefore, the inundation map must be reviewed in conjunction with the dambreak study when determining acceptability. **The information on the inundation map must be up-to-date and adequate for the development of a workable EAP. Therefore, it is recommended that the EAP text describe the areas affected by a dam failure.** The licensee should annually verify the accuracy of the information provided in the text describing the areas affected by inundation. The text could then be updated annually to reflect changes in the level of downstream development. Inundation maps should be up-dated to reflect changes in downstream areas in accordance with the five year cycle required in the EAP Guidelines for the complete reprinting and distribution of EAPs. Of primary importance, however, is up-to-date inundation maps, whereas, the text is supplemental interim information.

Inundation maps must conform to the requirements for mapping established in these Guidelines. The inundation map should clearly indicate the areas subject to flooding. **The maximum elevation, increase in water surface elevation (rise), peak discharge, and arrival time of the leading edge and peak of the flood wave at critical locations should be indicated on the inundation map and/or in a table. Based on experience, it is extremely important to show the arrival time of the leading edge of the flood wave on the inundation map.** If the map shows only the time of the peak elevation of the flood wave, the emergency preparedness agencies could be led into a false sense of security believing they have more time available to evacuate areas than actually exists. It is also important that the map be developed at a scale sufficient to be used for identifying downstream inhabited areas (including habitable structures, recreational areas, etc.) within the area subject to possible danger and that the inundated areas be clearly identified.

It is best to terminate flood routing after non-damaging levels are obtained. However, to avoid unnecessary study and costs, the routing may cease at a point where real-time flood warning information can be provided on a preplanned basis. For example, if it is known that the time of failure was 12:05 p.m. on Day 1 and the floodwave can be monitored, it may be possible to determine that the floodwave will reach Town X at approximately 4:20 p.m. on Day 3; hence, real-time flood warning information could be used. This may require coordination with the National Weather Service. If the licensee terminates the flood routing before non-damaging levels are obtained, then it should be clearly indicated that real-time flood warning information can be issued. **Since real time data are difficult to determine, this is not a recommended approach.** It will most likely require more than a day or two to obtain the information to model the actual failure, and known depths of flooding and travel times, to be able to reproduce and predict real-time situations. Thus, real time flood warning must be used selectively because of inaccuracies in predicting flood wave travel times. Again, for these and other reasons, the use of real-time flood warning is not encouraged.

In order for an EAP to be a workable and usable document for the jurisdictions affected, there are certain problems that need to be resolved by the jurisdictions. For instance, road names used by local officials may be different from those used on USGS maps or state route maps. The local agencies should be requested by the licensee to specifically check road names so that the EAP includes the names familiar to local residents. The agencies should be requested to furnish, by letter or other documentation, the road names used locally so that EAP maps can be appropriately modified. In addition, all bridges in the inundation area should be highlighted. It is recommended that a note be included on the map advising the users of the map that, because of the method and procedures used to develop the flooded areas, the limits of flooding shown are solely to be used as a guideline for the establishment of evacuation zones.

Since local officials will likely use the inundation map for evacuation purposes, the accuracy, limitations, and conditions for which the map was developed should be clearly understood. For example, when an inundation map is developed for a "fair weather" breach and it is only supplemented by a note indicating that failure under flood flow conditions would require evacuation to higher elevations, the evacuation agency personnel are placed in a difficult position to accurately determine by extrapolation the areas that may be impacted by a dambreak for some flood inflow condition greater than the one upon which the inundation maps are based. For this reason, numerous emergency preparedness agencies are requesting that the maximum flood level of potential adverse impact also be shown on the maps.

For consistency, the maximum flood level should be based on a hypothetical dam failure during the inflow design flood (IDF). The IDF is the flood inflow condition above which the failure of the dam has an insignificant effect on downstream flooding - see Chapter II. **Therefore, unless there is good reason to select other flood conditions under which the dam is assumed to fail, subject to the discussion in Section 6-2.2 (page 6-3), licensees should show both the "fair weather" and IDF dambreak flood levels as a means of developing a more**

effective EAP. The IDF level without failure should not be shown. The result will be inundation maps that show the extremes in area that could be inundated. This will be of substantial assistance to evacuation agencies that desire this information on the maps in order to better establish the evacuation zones. The **preferred** method of representing the two dambreak scenarios on the same maps is to identify the normal streamflow condition with one color, the area flooded by a "fair weather" breach with another color, and the differential increase in flooding between the "fair weather" breach and a failure during the IDF with yet another distinctive color. However, other methods that clearly identify differences between the two failure conditions are also acceptable.

FERC staff has been advised by some agencies that the two dambreak conditions are helpful to the evacuating agencies because they show the extremes in potential inundation, the difference in travel times between the two conditions, and how far downstream evacuation is required for each condition. **If, through coordination with the evacuation agencies, it is their conclusion that they need only one dambreak condition represented on the maps, or dambreak conditions under flood conditions different from normal flow and/or the IDF, then written documentation should be included in the EAP.**

6-2.4 Exemption Requirements

In order to receive an exemption from filing an EAP, a licensee must demonstrate that no reasonably foreseeable project emergency (i.e. failure of a dam or water retaining structure) would endanger life, health or property. To satisfactorily demonstrate the consequences of a failure, the licensee will have to submit a report that documents all reconnaissance and other studies performed to determine that failure of the dam will not present a hazard to human life or cause significant property damage under all flood flow conditions up to the Inflow Design Flood. Regional Office staff are to periodically review the circumstances pertaining to those projects that have already been exempted from EAP requirements to determine if additional documentation is necessary to verify the validity and continuation of previously granted EAP exemptions.

If the results of a field reconnaissance study of the areas downstream of the dam are inconclusive in determining the hazard potential of the dam, a dambreak analysis should be performed and results of the analysis furnished in the report. The dambreak analysis should consider failure under normal operating conditions and flood flows up to the point where no significant increase in hazard to downstream life and property occurs as a result of failure, i.e. the inflow design flood. For each flood event analyzed, it should be assumed that the failure is initiated when the peak flow or reservoir elevation is reached. As discussed in detail in Chapter II of the Engineering Guidelines, dam failure should be assumed to occur at the peak and not on the rising limb of the inflow flood hydrograph. A sensitivity analysis should also be performed to establish the effect of breach width and time to failure on downstream flood levels at various flood flow conditions.

Chapter II, Appendix II-C, of the Engineering Guidelines discusses in detail the procedure for performing a hazard evaluation. An inundation map and, if necessary, water surface profiles, should be developed and furnished for the flow condition which results in the greatest potential for loss of life and significant property damage. The method and assumptions utilized in the dambreak analysis should be fully documented. The inundation map and water surface profiles should delineate the affected areas and water surface elevations prior to failure with the dam in place and after the assumed failure. The map and river profiles should also show the travel time for the arrival of the initial or leading edge of the flood wave and the peak elevation of the flood wave at critical locations downstream of the dam. It is important that the inundation map be developed at a scale sufficient to be used for identifying the location of downstream inhabitants within the area subject to possible danger. The licensee should annually verify the accuracy of the information on downstream development that appears on the inundation maps. The licensee should perform a field reconnaissance to verify that the information on the inundation maps is as accurate as possible and document this in writing to the Regional Director. If there are any changes in downstream development, it will be necessary to evaluate whether the exemption remains valid.

6-3 EAP PREPARATION

6-3.1 General

All EAPs, except for those at government dams, are to conform to the format and criteria established in these Guidelines. This format should facilitate the preparation, updating, and annual review of an EAP. It should be used in conjunction with the instructions contained in Part 12, Subpart C of the Commission's Regulations. The format was developed to include all of the pertinent information to be included in the EAP as required by the Commission's Regulations. It is important that the inundation maps conform to the criteria discussed in these Guidelines so that they will be of sufficient scale to clearly identify all impacted areas. The initial EAP shall be submitted in a loose-leaf binder, whereby outdated pages or the entire EAP (every five years or less) can be easily removed and replaced by updated information to ensure a complete, current, and workable plan.

6-3.2 Basic Considerations for Preparing Emergency Action Plans

-3.2.1 Purpose

There are many types of emergency events that could affect dams. Whenever people live in areas that could be flooded as a result of failure of or operation at a dam, there is a potential for loss of life and damage to property. The general purpose of these Guidelines is to encourage thorough and consistent emergency action planning to help save lives and reduce property damage in areas that would be affected by dam failure or operation.

An Emergency Action Plan, or EAP, is a formal document that identifies potential emergency conditions at a dam and specifies preplanned actions to be followed to minimize property damage and loss of life. The EAP specifies actions the licensee should take to minimize or alleviate the problems at the dam. It contains procedures and information to assist the licensee in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show the emergency management authorities the critical areas requiring action in case of an emergency.

An **emergency** in terms of dam operation is defined as an impending or actual sudden release of water caused by an accident to, or failure of, a dam or other water retaining structure, or the result of an impending flood condition when the dam is not in danger of failure. The release of water may endanger human life or downstream property.

The effectiveness of an Emergency Action Plan program is enhanced by promoting a uniform format for EAPs which ensures that all aspects of emergency planning are covered in each plan. Uniform Emergency Action Plans and advance coordination with local and state emergency management officials and organizations should facilitate a timely response to a developing or actual emergency situation.

6-3.2.2 Scope

These Guidelines are used for preparing or revising Emergency Action Plans and apply to all dams unless exempted under Part 12, Subpart C, 12.21 (Section 6-2.4). Ownership and development of the floodplain downstream from dams varies; therefore, the potential for loss of life as a result of failure or operation of a dam will also vary. **Every EAP must be tailored to site-specific conditions.**

Emergency Action Plans generally contain six basic elements:

- Notification Flowchart
- Emergency Detection, Evaluation, and Classification
- Responsibilities
- Preparedness
- Inundation Maps
- Appendices

All of the elements should be included in a complete EAP. The licensee is responsible for the development of the EAP. However, the development or revision of an EAP must be done in coordination with those having emergency management responsibilities at the state and local levels. Emergency management agencies will use the information in a licensee's EAP to facilitate the implementation of their responsibilities. State and local emergency management authorities will

generally have some type of plan in place, either a Local Emergency Operations Plan or a Warning and Evacuation Plan.

6-3.2.3 The Six Basic Elements of an EAP

This section lists and briefly examines why there is a need for the six basic elements of an EAP. The requirements of these elements are discussed in detail in 6-3.3 of this chapter, which presents a format for uniformity among EAPs.

A. Notification Flowchart. A notification flowchart shows who is to be notified, by whom, and in what priority. The information on the notification flowchart is necessary for the timely notification of persons responsible for taking emergency actions.

B. Emergency Detection, Evaluation, and Classification. Early detection and evaluation of the situation(s) or triggering event(s) that initiate or require an emergency action is crucial. The establishment of procedures for reliable and **timely** classification of an emergency situation is imperative to ensure the appropriate course of action is taken based on the urgency of the situation. It is better to activate the EAP while confirming the extent of the emergency, than waiting for the emergency to fully develop.

C. Responsibilities. A determination of responsibility for EAP-related tasks must be made during the development of the plan. Licensees are responsible for developing, maintaining, and implementing the EAP. State and local emergency management officials having statutory obligation are responsible for warning and evacuation within affected areas. The EAP must clearly specify the licensees responsibilities to ensure effective, timely action is taken should an emergency occur at the dam. The EAP must be site-specific, since conditions at and downstream of all dams are different.

D. Preparedness. Preparedness actions are taken to moderate or alleviate the effects of a dam failure or operational spillway release and to facilitate response to emergencies. This section identifies actions to be taken prior to any emergency.

E. Inundation Maps. An inundation map should delineate the areas that would be flooded as a result of a dam failure. Inundation maps are used both by the licensee and emergency management officials to facilitate timely notification and evacuation of areas affected by a dam failure or flood condition. These maps greatly facilitate notification by graphically displaying flooded areas and showing travel times for wave front and flood peaks at critical locations.

F. Appendices. The appendices contain information that supports and supplements the material used in the development and maintenance of the EAP.

6-3.2.4 Coordination

It is vital that development of the EAP be coordinated with all entities, jurisdictions, and agencies that would be affected by a dam failure and/or flooding as a result of large operational releases, or that have statutory responsibilities for warning, evacuation, and post-flood actions. The finished product should be user friendly as it realistically takes into account each organization's capabilities and responsibilities.

Coordination with state and local emergency management officials at appropriate levels of management responsible for warning and evacuation of the public is essential to ensure that there is agreement on their individual and group responsibilities. Participation in the preparation of the EAP will enhance their confidence in the EAP and in the accuracy of its components. Coordination will provide opportunities for discussion and determination of the order in which public officials would be notified, backup personnel, alternate means of communication, and special procedures for nighttime, holidays, weekends, etc.

The tasks and responsibilities of the licensee and the emergency management officials that would be implemented during a dam emergency incident need to be as compatible as possible.

To facilitate compatibility, the licensee should coordinate emergency response actions with the local emergency management officials who have the responsibility to provide a timely warning and evacuation notice to populations at risk. This should help prevent over, or under, reaction to the incident by various organizations.

6-3.2.5 Evacuation

State and local officials who are charged with the safety of the public who live in areas that would be inundated by failure of a dam or flood releases are responsible for evacuation planning and implementation during a dam emergency. The licensee should not usurp the responsibility of the local authorities responsible for evacuation. However, there may be situations where recreational facilities, campgrounds, or residences may be located below a dam where local authorities would not be able to issue a timely warning. In such cases, the licensee should coordinate with local emergency management officials to determine who will warn these people and in what priority. Evidence of coordination between the licensee and the alerting agencies should be provided in the EAP.

6-3.2.6 Emergency Duration, Security, Termination, and Follow-up

An Emergency Action Plan needs to address who in the licensee's organization issues status reports during the emergency, when and how a declared emergency will be terminated, what security provisions shall be maintained at the dam, and plans for a follow-up evaluation and report.

A. Emergency Duration. Emergency situations that occur at a dam will require that status reports and situation assessments be provided by the licensee to appropriate organizations throughout the duration of the incident.

B. Security Provisions. An Emergency Action Plan should consider security provisions at, and surrounding, the dam during emergency conditions in order to protect the public and permit effective performance of emergency response actions.

C. Emergency Termination. There are two conditions requiring a termination of the emergency. One has to do with emergency conditions at the dam and the other is related to the evacuation and disaster response. The licensee is usually responsible for making the decision that an emergency condition no longer exists at the dam. The EAP should clearly designate the responsible party. The applicable state or local emergency management officials are responsible for termination of the evacuation or disaster response activities.

The licensee and state and local officials should agree on when it is appropriate to terminate an emergency. The licensee should cooperate with state and local officials to determine if a news release is appropriate which can be used by the media for broadcast to the general public notifying them of termination of the emergency condition. Such news releases are expected to be a supplement to other methods of notifying the public that the emergency has been terminated.

D. Follow-up Evaluation. Following an emergency, an evaluation and review should be conducted by the licensee that includes input from all participants. The following should be discussed and evaluated in the after-action review:

- Events prior to, during, and following the emergency;
- Significant actions taken by each participant, and what improvements would be practicable for future emergencies; and
- All strengths and deficiencies found in procedures, materials, equipment, staffing levels, and leadership.

The results of the after-action review should be documented in an evaluation report chaired by the licensee and used as a basis for revising the Emergency Action Plan.

6-3.2.7 Maintaining an Emergency Action Plan

After the Emergency Action Plan has been developed, approved, and distributed, the job is not done. Without periodic maintenance, the EAP will become out-dated, lose its effectiveness, and no longer be workable. If the plan is not exercised (verified), those involved in its implementation may become unfamiliar with their roles and responsibilities, particularly if emergency response personnel change. If the plan is not updated, the information contained in it may become outdated and useless. Maintaining an Emergency Action Plan is addressed in greater detail in 6-4 of this chapter.

6-3.3 EAP Format

6-3.3.1 The Format

A format is provided in these Guidelines to ensure all six basic elements are included in an EAP, to provide uniformity, and to encourage thorough and consistent emergency action planning for levels of preparedness that may save lives and reduce property damage in areas affected by dam operation or failure. It is important that licensee and regulatory requirements be satisfied when selecting a format for an EAP.

Although it is not necessary to exactly follow the format outlined below, it is necessary that all EAPs within a given jurisdiction be similar and consistent to eliminate confusion when activating any EAP. To the extent possible, an EAP should be organized in the format that is most useful for those involved in the plan. The EAP must be user friendly so that it will actually be used during EAP exercises and actual emergency events. Regardless of the format used, development of an EAP should consider the elements described on the following pages to ensure all aspects of emergency action planning are covered.

It is helpful to place the EAP in a loose-leaf binder, so that outdated pages (or the entire EAP) can be easily removed and replaced with updated information, to ensure a complete, current, and workable plan. It is also beneficial to place the date of the EAP or current revisions on each page.

The format for an EAP appears below:

EAP FORMAT

Title Page/Cover Sheet

Table of Contents

- I. Notification Flowchart
- II. Statement of Purpose
- III. Project Description
- IV. Emergency Detection, Evaluation, and Classification
- V. General Responsibilities Under the EAP
 - A. Licensee Responsibilities
 - B. Responsibility for Notification
 - C. Responsibility for Evacuation
 - D. Responsibility for Termination and Follow-Up
 - E. EAP Coordinator Responsibility
- VI. Preparedness
 - A. Surveillance
 - B. Response During Periods of Darkness
 - C. Access to Site
 - D. Response During Weekends and Holidays
 - E. Response During Periods of Adverse Weather
 - F. Alternative Systems of Communication
 - G. Emergency Supplies and Information
- VII. Inundation Maps
- VIII. Appendices
 - A. Investigation and Analyses of Dambreak Floods
 - B. Plans for Training, Exercising, Updating, and Posting the EAP
 - C. Site Specific Concerns
 - D. Documentation
 - E. Approval of the EAP

The format separates an EAP into two distinct sections: the basic EAP and the Appendices. Together, these sections constitute a complete EAP.

A. The Basic EAP. Sections I through VII of the format constitute the basic Emergency Action Plan. That is, they contain information that should be used by all parties (both the licensee and emergency management officials) during an actual emergency. For example, the licensee will use the notification flowchart to issue its emergency warning to the appropriate officials in a prioritized order. Similarly, the emergency management officials should use the flowchart to contact other officials or the licensee, as needed, throughout the emergency. As a second example, both the licensee and the emergency management officials will use the inundation maps extensively in fulfilling their responsibilities.

It must be remembered that the responsibilities of the state and local emergency management authorities and other organizations in the jurisdictions affected by a dam failure or flooding as a result of operation of a dam are not included in an EAP. Information unique to state and local emergency management authorities, and any other organizations who would have responsibilities for the warning and evacuation of populations at risk, would be included in the portion(s) of the appropriate jurisdiction's Emergency Operations Plan dedicated specifically to warning and evacuation of populations placed at risk as a result of dam failure or flooding due to large operational releases. However, the information in the EAP must be coordinated with the appropriate authorities since they will depend on and use the information in the licensee's EAP to help them carry out their responsibilities.

B. The Appendices. The Appendices are also an important element which completes the EAP. However, the information contained in the Appendices is not necessarily needed by all parties during an actual emergency. They typically contain support materials used in the development of the basic EAP. More specifically, the Appendices focus on such important issues as those that specifically address maintenance requirements for the EAP and dambreak investigations and analyses, among others. This information may be directly applicable to the actions of the licensee and possibly some of the emergency management parties, but may not be critical to the actions and activities of other parties during an actual emergency.

All emergency management officials should be offered the complete EAP. However, it may be left to their discretion to decide whether they want to receive a copy of the complete EAP (basic EAP + Appendices) or just the basic EAP. **Those who opt to receive just the basic EAP should understand that if it does not provide sufficient information for them to perform their functions, then they should obtain the complete EAP.**

NOTE: *Every EAP must be tailored to site-specific conditions and to the requirements of the organization that owns, operates, or regulates the use of the dam. This can be accomplished under the format. Uniformity of EAPs is important because any one state or local emergency management agency may be affected by a river system that has a series of dams, the independent failure or operation of which may impact the jurisdiction. Uniformity provides for clarity and better understanding of the information in the EAP for each individual dam.*

6-3.3.2 Format Items Defined

This section follows the heading and numbering of the format and describes in detail each element of an EAP.

Title Page/Cover Sheet

An EAP document's cover identifies it as an Emergency Action Plan and specifies the dam for which it was developed. Since each dam must have its own EAP with its own specific procedures to be followed, title pages or cover sheets are essential, so personnel can be sure that they are using the right EAP for the circumstances. To assist state and federal dam safety personnel, include the National Inventory of Dams number unique to each dam on the title page. A sample title page is included in Appendix VI-C.

Table of Contents

List all major items in the Table of Contents, including flow charts, figures, tables, etc. A sample table of contents is included in Appendix VI-C.

I. Notification Flowchart

The EAP should begin with one Notification Flowchart that clearly summarizes the following information and is applicable to each of the emergency classification levels considered (See discussion under item IV):

- Who is responsible for notifying each licensee representative(s) and/or emergency management official(s).
- What is the prioritized order in which individuals are to be notified.
- Who is to be notified.

The notification flowchart should include individual names and position titles, office and home telephone numbers, alternative contacts and means of communication (e.g., radio call numbers). The number of persons to be notified by each responsible individual on the notification flow chart should be governed by what other responsibilities the person has been assigned. It is usually recommended that individuals not be responsible for contacting any more than three or four other parties.

The notification list should consider the following:

- Licensee.
- Local emergency management officials and other organizations.
- Appropriate federal and state emergency management agencies.
- Residents and property owners that are located immediately downstream of the dam within the boundary of potential inundation where available warning time is very limited.
- Operators of other dams or water-retention facilities.
- Managers and operators of recreation facilities.

- National Weather Service
- News media.¹
- Others, as appropriate.

Although the list is not all inclusive, nor a prioritization of those entities listed, both the licensee and the local, state, and federal emergency management authorities are typically given top priority in the notification flowchart.

The Notification Flowchart should be easy to follow for each emergency classification level (see Section IV). **A single flowchart that represents all levels is preferred**, for the sake of effectiveness and simplicity. However, under certain conditions for clarity it might be necessary to develop a flowchart for each classification level. Color coding (i.e. using different colored lines to trace the proper sequence of notification under various emergency classification levels) may prove helpful. If necessary, narrative information supplementing the flowchart may be provided on the page following the flowchart.

NOTE: *Information is exchanged both up and down the notification flowchart.*

Copies of the flowchart should be readily available to each individual having responsibilities under the plan, and should be kept up-to-date through exercises and revisions.

A sample Notification Flowchart is shown on the next page.

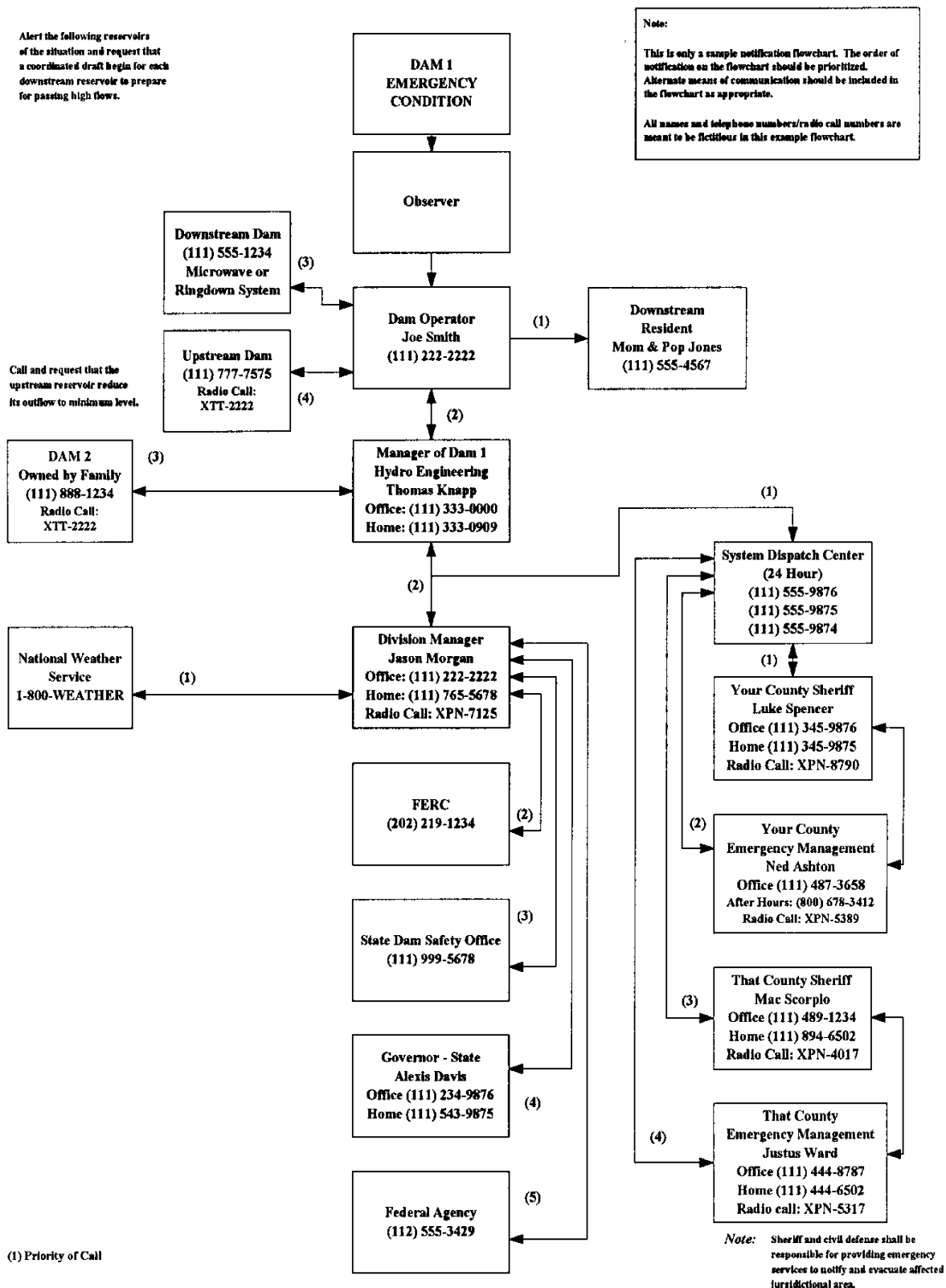
NOTE: *This is only a sample flowchart. A flowchart must be tailored to the specific needs and notification priorities of the dam to which it applies.*

¹

The news media, including radio, television, and newspapers, should be utilized to the extent available and appropriate. Use of new media should be preplanned to the extent possible by the licensee or emergency management officials. Notification to the news media may be by the licensee or emergency management officials depending on the type of emergency. Notification plans should define emergency situations for which each medium will be utilized and should include an example of a news release that would be the most effective for each possible emergency. Information for media ordinarily should not be relied upon as the primary means of warning.

SAMPLE NOTIFICATION FLOWCHART

Alert the following reservoirs of the situation and request that a coordinated draft begin for each downstream reservoir to prepare for passing high flows.



II. Statement of Purpose

Following the Notification Flowchart, briefly state the purpose and scope of the EAP. Two examples of a statement of purpose are shown below.

Example 1: "This plan defines responsibilities and provides procedures designed to identify unusual and unlikely conditions which may endanger Any Dam in time to take mitigative action and to notify the appropriate emergency management officials of possible, impending, or actual failure of the dam. The plan may also be used to provide notification when flood releases will create major flooding."

Example 2: "The purpose of this Emergency Action Plan (EAP) is to safeguard the lives and reduce damage to the property of the citizens of Alpha County living along Beta Creek, in the event of failure of the Beta Creek Dam or flooding caused by large runoff."

III. Project Description

Provide a description of the project and its location. Include a project vicinity map and a simple drawing showing project features. List any significant upstream or downstream dams. List downstream communities potentially affected by a dam failure or by flooding as a result of large operational releases. List and highlight critical site specific concerns (i.e., critical operating procedures and material stockpiles) and refer the reader to more specific information contained in Appendix C of the EAP document.

IV. Emergency Detection, Evaluation, and Classification

The EAP document should include a discussion of procedures for timely and reliable detection, evaluation, and classification of an existing or potential emergency condition.

The conditions, events, or measures for **detection** of an existing or potential emergency should be listed. Data and information collection systems (early warning system hardware, rule curves or other information related to abnormal reservoir levels, inspection/monitoring plan, inspection procedures, instrumentation plan, etc.) should be discussed. The process that will be used to analyze incoming data should also be described.

Procedures, aids, instruction, and provisions for **evaluation** of information and data to assess the severity and magnitude of any existing or potential emergency should be discussed.

Emergencies are classified according to their severity and urgency. An emergency **classification** system is one means to classify emergency events according to the different times at which they occur and to their varying levels of severity. The classification system indicates the urgency of the emergency

condition. **Emergency classifications should use terms agreed to by the licensee and emergency management officials during the planning process, in order for the system to work and to ensure organizations understand terminology and respond appropriately to the event.**

Titles for emergency classifications should be chosen carefully by the organizations who will use them so that everyone will understand what each classification level means when notifications are issued and received.

Declaration of an emergency can be a very controversial decision. The issue should not be debated too long. An early decision and declaration is critical to maximize available response time.

Some locations may require only two emergency classifications, while others may require more. For the purpose of these EAP Guidelines, **two dam failure emergency classifications** and one **non-failure emergency classification** are provided:

- Failure is imminent or has occurred (Condition A).
- Potential failure situation is developing (Condition B).
- Non-failure emergency condition.

The definition of these conditions follows:

- **Failure is imminent or has occurred (Condition A)**

Generally, this situation should convey the impression that "time has run out" with respect to the failure of the dam. This is a situation where a failure either has occurred, is occurring, or obviously is just about to occur. The question is often asked, "how much time is available when failure is considered to be imminent?" It is impossible to determine how long it will take for a failure to occur or for a complete breach to occur once failure begins. **Therefore, once a licensee determines that there is no longer any time available to attempt corrective measures to prevent failure, the "failure is imminent or has occurred" warning should be issued.** Emergency management agencies, for evacuation purposes, should conservatively interpret the phrase "failure is imminent" to mean that the dam is failing. It should not be assumed that there is any time lag between "failure is imminent" and a "failure has occurred." Therefore, "failure is imminent" and "failure has occurred" should conservatively be interpreted as essentially the same condition for evacuation purposes.

- **Potential failure situation is developing (Condition B)**

Generally, this situation should convey the impression that "some amount of time" is still available for further analyses/decisions to be made before dam failure is considered to be a foregone conclusion. This is a situation where a failure may eventually occur, but pre-planned actions taken during certain events (such as major floods, earthquakes, evidence of piping, etc.) may moderate or alleviate failure. Even if failure is inevitable, more time is generally available than in a failure has occurred situation to issue warnings and/or take preparedness actions.

Is the time frame for this situation in hours, days, or weeks? When a dam safety situation is observed that may lead to a failure if left unattended, but there is no immediate danger, the licensee should issue a warning that a "potential failure situation is developing". The licensee should assess the situation and determine the urgency of the emergency situation. Based on the licensee's assessment (and as a result of prior coordination with the appropriate authorities), the authorities should be placed on alert and it is up to the authorities to determine the appropriate course of action.

If it appears that a situation may take days or weeks before it could develop into a failure situation, the local authorities may decide on one course of action. Periodic status report updates from the licensee are important because when it appears that the situation is continuing to worsen at the dam, in spite of the actions being taken to moderate or alleviate failure, the local authorities may decide to change their course of action. Depending on the location of downstream residents with respect to the dam and the estimated warning time available, the evacuating agencies should consider the prudence of early evacuation, or heightened awareness, of certain downstream areas until the emergency has passed.

NOTE: *It should be remembered that it may be appropriate to immediately declare a Condition A. However, there should be smooth transition from Condition B to Condition A when using Condition B initially.*

To assist the evacuating agencies in selecting their appropriate course of action and to provide a proper transition from Condition B to Condition A, the licensee should clearly communicate their assessment of the situation to the agencies. The licensee should consider placing the agencies on an initial alert and provide periodic updates on the situation as it develops so that the agencies can assess when they should implement their evacuation procedures. For example, a licensee could issue an initial warning and periodic updates on the reservoir level as it rises during flood conditions and eventually overtops an embankment dam. As the reservoir rises, "a potential failure situation is developing" warning should be implemented with periodic updates on how much time is available before the embankment overtops. Immediately before the embankment overtops, a "failure is imminent or has occurred" warning should be issued.

- **Non-failure Emergency Condition**

Generally, this situation should be used when there is no danger of dam failure, but flow conditions are such that flooding is expected to occur downstream of the dam. Non-failure emergency conditions are more common than the failure emergency conditions. Use of the EAP can provide an early warning to downstream areas during flood conditions or large spillway releases. Based upon the severity of the flooding, local site conditions, consultations with local emergency response agencies, and standard operating procedures used at the dam, the EAP may not need to be activated during a non-failure emergency condition. However, it may become necessary to fully activate the EAP if conditions escalate to levels agreed to beforehand by all involved participants. Therefore, an important application of the EAP is when there is a flood occurring on the river system, but there may be no apparent threat to the integrity of the dam. In this situation, natural flooding is expected or is in progress upstream from the dam site and an impending or actual release of water to downstream areas will result from unusually large spillway releases or passage of unusually large flows at dams having uncontrolled spillways. The licensee provides an important public service by notifying the appropriate agencies of the expected release or passage of flood waters below the dam. While the amount of flooding may be beyond the control the licensee, information on the amount of releases from the dam is very helpful to the authorities in reaching any decisions on the need for evacuation. Site specific concerns will dictate the level of notification necessary during a non-failure emergency condition.

V. General Responsibilities Under the Plan

The plan should specify the person(s) or organization responsible for the maintenance and operation of the dam and the persons or groups responsible for implementing various phases of the EAP. Some specific responsibilities to be considered are discussed below.

A. Licensee's Responsibilities. The duties of the licensee or owner's designated representatives under the EAP should be clearly described. Suggested information to include in this section include, but are not limited to the following:

The operators should be advised of the importance of the Emergency Action Plan and why the EAP is necessary. The operators' duties under the EAP should be described. Include pointers on how to communicate the emergency situation to those who need to be contacted along with samples of typical communications.

Specific actions operators are to take after implementing the EAP notification procedures should be described. For example, opening spillway gates, especially if a certain sequence is desired, and opening/closing water intakes, as appropriate. Instructions for the operation of the project during the anticipated emergency should be provided.

The chain of command should be described. Officials and alternates of the licensee that must be notified should be designated and a priority of notification determined. Notification of supervisory personnel on the licensee's staff is desirable, if time permits. Advice may be needed concerning predetermined remedial action to delay, moderate, or alleviate the severity of the emergency condition. The responsibilities required by the EAP should be coordinated with appropriate levels of management to ensure full awareness of organizational capabilities and responsibilities. EAPs must always be developed as a result of coordination and consultation with other entities and agencies that will be affected by a failure of a dam, or large operational releases, or have statutory responsibilities in warning and evacuation.

B. Responsibility for Notification. The person(s) authorized to notify state and local officials should be determined and **clearly identified** in the EAP. If time allows in an emergency situation, onsite personnel should seek advice and assistance. However, under certain circumstances, such as when failure is imminent or has occurred, the responsibility and authority for notification may have to be delegated to the dam operator or a local official. Such situations should be specified in the EAP.

The accurate and timely dissemination of emergency public information is very important to the overall success of an EAP. The person who is responsible for disseminating information to the media and the public on a periodic basis throughout the emergency should be designated. If resources are available, an exclusive public information officer should be identified to disseminate all media briefs. Also, means for keeping local authorities advised of continuing conditions at the dam should be described.

Licensees should develop procedures for dissemination of *dam specific* information to the media in anticipation of questions the media may have about the incident as it applies to the dam. A procedure like this should, in effect, help minimize the potential for dissemination of misinformation and spreading of false rumors.

Throughout the United States, the National Weather Service (NWS) and/or other agencies have the general responsibility for issuing flood warnings. Include the appropriate agency having this responsibility on the notification chart so that its facilities can enhance warnings being issued.

Local agencies will usually establish an Emergency Operations Center (EOC), or Incident Command System (ICS), to serve as the main distribution center for warning and evacuation activities. The availability of specific local resources should be determined through discussion and orientation seminars with local agency personnel. Proper coordination and communication among onsite technical personnel at the dam, public information officer(s), and emergency personnel at the EOC is critical to a successful EAP. Thorough verification during comprehensive EAP exercises will greatly assist in providing this smooth interface.

C. Responsibility for Evacuation. Warning and evacuation planning are the responsibilities of local authorities who have the statutory obligation. Under the EAP the licensee is responsible for notifying

the appropriate emergency management officials when flooding is anticipated, a dam failure is imminent or has occurred, or a potentially hazardous situation is developing.

Licenses should not assume, nor usurp, the responsibility of government entities for evacuation of people. However, there may be situations in which routine notification and evacuation will not suffice, as in the case of a resident located just downstream of the dam. In this case, the licensee should arrange to notify that person directly. **This procedure should be coordinated with the appropriate public officials prior to an emergency situation developing.**

D. Responsibility for Duration, Security, Termination, and Follow-Up. A person should be designated for on-site monitoring of the situation at the dam and keeping local authorities informed of developing conditions at the dam from the time that an emergency starts until the emergency has been terminated.

Provisions for security measures at the dam during the emergency should be specified.

A person should also be responsible for declaring that the emergency at the dam is terminated. The applicable state or local emergency management officials are responsible for termination of the disaster response activities.

A follow-up evaluation after an emergency by all participants should be specified. The results of the evaluation should be documented in a written report.

E. EAP Coordinator Responsibility. The licensee should specify in the EAP the designated EAP coordinator who will be responsible for EAP-related activities, including (but not limited to) preparing revisions to the EAP, establishing training seminars, coordinating EAP exercises, etc. This person should be the EAP contact if any involved parties have questions about the plan.

VI. Preparedness

Preparedness actions are taken to prevent a dam failure incident, or to help reduce the effects of a dam failure or operational spillway release and facilitate response to emergencies. A few of the preparedness actions that a licensee may take include providing emergency flood operating instructions, and arranging for equipment, labor, and materials for use in emergency situations.

The EAP should describe preparedness actions taken both prior to and following the development of emergency conditions. Preparedness actions involve the installation of equipment or the establishment of procedures for one or more of the following purposes:

- Preventing emergency conditions from developing, if possible, or warning of the development of emergency situations.

- Facilitating the operation of the dam to limit impacts in an emergency situation.
- Minimizing the extent of damage resulting from any emergency situations that do develop.

The need for **timely** action in an emergency situation cannot be overemphasized. The EAP should contain a discussion of provisions for surveillance, and evaluation of an emergency situation and should clearly indicate that emergency response procedures can be implemented in a timely manner. An important factor in the effectiveness of the EAP is the prompt detection and evaluation of information obtained from instrumentation and/or physical inspection procedures.

In the EAP, discuss the time factor from the actual occurrence of an emergency to awareness of the emergency, and its effect on the workability of the EAP. **Timely implementation of the EAP and coordination and communication with downstream local authorities are crucial elements in the effectiveness of emergency response to the incident.**

There are several types of preparedness actions that should be considered when developing an EAP. These actions include:

- Surveillance
- Response during periods of darkness
- Access to the site
- Response during weekends and holidays
- Response during periods of adverse weather
- Alternative systems of communication
- Emergency supplies and information

The following sections discuss each of these actions:

A. Surveillance. The EAP should contain a discussion of provisions for surveillance, detection and evaluation of an emergency situation and should clearly indicate that the EAP can be implemented in a timely manner.

When a dam is not continuously attended and dam failure or operational releases would endanger human life or cause significant property damage, it is imperative that procedures be developed to identify conditions requiring emergency actions, and to promptly alert emergency management officials responsible for warning and evacuation of residents who would be affected in the event of an emergency at the dam. In order to be able to promptly notify responsible officials of emergency conditions, a licensee should be able to detect and evaluate developing emergency conditions. The information system must be able to deliver clear, concise, and reliable data so that the responsible official(s) may react with confidence and implement the EAP. While the EAP is being activated, personnel should visit the site to verify conditions.

For an unattended dam, a remote surveillance system that includes instrumentation and telemetering facilities at the dam site should be considered to provide a continuous reading of headwater and tailwater levels. If the licensee has an operations control center that is attended 24 hours a day, the system should include a computer at the operations center to monitor the data, and to activate an audible alarm whenever the rate of change of the headwater or tailwater over a given period of time exceeds prescribed limits. The alarm also should be activated if the headwater or tailwater elevations exceed prescribed maximum or minimum levels. The design must be site-specific. The limits programmed in a system must account for changes in headwater and tailwater levels that would occur during normal dam operation, floods, maintenance, etc.

Monitoring of the tailwater generally is more sensitive to changes resulting from a breach of the structures than monitoring the headwater. Changes in tailwater will alert operators more quickly to site conditions and help determine whether emergency management officials should be notified. If continuous readings of both the headwater and tailwater are available, the operator can obtain a current reading at any time and check conditions at the site after an alarm is sounded.

Provisions should be made for the alarm to sound when there is an interruption of power to, and loss of communication with, the monitoring instrumentation. (When a dam tender lives close to the project, an alarm should be installed in the dam tender's house.) When power to or communication with the site is interrupted, the dam should be staffed until conditions are returned to normal. Operation of the alarms should be checked and tested periodically. For instance, annual testing of the EAP might be initiated by artificially tripping one of the alarms.

Reaction time must be minimized when inhabited structures are located immediately downstream of the dam. When these conditions exist, special procedures may need to be included in the EAP to notify the specific occupants involved. Local officials should be fully involved in the development of these special procedures.

The EAP should describe any instrumentation for monitoring the behavior of unattended dams, and explain how warning systems would be activated. Instrumentation responses should be instantaneous to facilitate immediate action by operators.

Procedures should be described for providing continuous surveillance for periods of actual or forecasted high flows. It may be necessary to send an observer to the dam during these periods, and not rely on the instrumentation alone. It is very important that an observer, with a means of portable communications, be at the dam when flood conditions or signs of serious structural distress have been identified.

If a discussion of remote surveillance at the dam is not applicable, that fact should be stated in the EAP.

B. Response During Periods of Darkness. Discussion in the EAP of the response to potential or actual emergency conditions during periods of darkness should be addressed.

Actions to be taken to illuminate the spillway, operating deck, or observation of distressed areas of the dam, and other actions that will facilitate the operation of gates or other emergency equipment should be described.

Any special procedures for contacting or notifying the proper personnel, local officials, or others during a power failure should be described.

The expected response time for verifying an emergency and implementing the EAP should be discussed in detail.

Any other special instructions for the dam operators or local officials should be included.

C. Access to the Site. The description of access should focus on primary and secondary routes and means for reaching the site under various conditions (e.g., foot, boat, helicopter, snowmobile, etc.). Also discuss in detail the expected response (travel) time. Special attention should be given to access if the main access road crosses the downstream channel and could be closed by flood waters.

D. Response During Weekends and Holidays. Discussion of emergency response during weekends and holidays should be included in this section.

The actions to be taken should be described in detail. Actions should be based on the dam tender schedule for attendance during this period.

Any special procedures for contacting or notifying personnel should be described.

E. Response During Periods of Adverse Weather. Discussion of emergency response under adverse weather conditions should be included.

The actions to be taken should be described in detail. Action should be based on whether the dam is attended or unattended.

Methods of access to the site (e.g., foot, boat, snowmobile) should be described.

The expected response time should be discussed in detail.

Any other special instructions for the dam operators or local officials should be listed.

F. Alternative Systems of Communication. The description of the availability and use of alternative communications systems at the site should be included.

Alternative channels of communication to be used in case of failure of the primary system or failure of other systems immediately available should be listed.

Proper procedures for activating the alternative channels of communication should be described.

Any other special instructions should be included.

G. Emergency Supplies and Information. There are certain planning and organizational measures that can help the licensee and local officials manage emergency situations more safely and effectively. These measures include stockpiling materials and equipment for emergency use and coordinating information. Also, alternative sources of power for spillway gate operation and other emergency uses should be provided. The EAP should list the location of each power source, its mode of operation, and if portable, the means of transportation and routes to be followed. The EAP should include the name and day/night telephone numbers of each operator or other responsible person.

If any of these measures apply, they should be discussed in the EAP. Specific types of information to include when describing these emergency supplies and information follow.

1. Stockpiling Materials and Equipment. Where applicable, document:

Materials needed for emergency repair, and their location, source, and intended use. Materials should be as close as possible to the dam site.

Equipment to be used, its location, and who will operate it.

How the operator or contractor is to be contacted.

Any other people who may be needed (e.g., laborers, engineers), and how they are to be contacted.

Also include any other special instructions. If stockpiling of materials and equipment is not applicable to your dam, that fact should be stated in your EAP.

NOTE: *For each applicable item, include specific contacts and their business and non-business means of communication.*

2. Coordination of Information. Where applicable, describe:

The need for coordination of information on flows based on weather and runoff forecasts, failure, and other emergency conditions. Describe how the coordination is achieved and the chain of communications, including names and day/night telephone numbers of responsible people. Coordination with the National Weather Service (NWS) or other appropriate agency is recommended to monitor storms, river stages, and flood waves resulting from a dam break. The NWS or other appropriate agency may also be able to supplement the warnings being issued by using its own communication system.

Additional actions contemplated to respond to an emergency situation or failure at an unattended dam. Include periods of darkness, inclement weather, and non-business hours.

Actions to be taken to lower the reservoir water surface elevation, if applicable. Describe when and how this action should be taken. If not applicable, that fact should be stated in the EAP.

Actions to be taken to reduce inflow to the reservoir from upstream dams or control structures. The EAP should provide instructions for operators or other persons responsible for contact with other owners on when and how these actions should be taken. If such actions do not apply, that fact should be stated in the EAP.

Actions to be taken to reduce downstream flows, such as increasing or decreasing outflows from downstream dams or control structures on the waterway on which the dam is located or its tributaries. The EAP should provide instructions for operators or other responsible persons on when and how these actions should be taken. If such actions do not apply, that fact should be stated in the EAP.

Also describe any other appropriate actions to be taken. If coordination of information on flows is not applicable, that fact should be stated in the EAP.

3. Other Site Specific Actions.

Describe any other site-specific actions devised to moderate or alleviate the extent of possible emergencies.

VII. Inundation Maps

Inundation maps are necessary and should be developed by the licensee in coordination with the appropriate state and local emergency management agencies. Since those agencies will rely heavily on the maps during an emergency it is important that the maps contain information required by those agencies. The inundation map must show the following:

The antecedent flow conditions on which the maps are based should be identified. Many local emergency management and response organizations request maps showing both a "sunny day" failure condition and a flood failure condition to show the expected extremes in peak water surface elevations, travel times and distances downstream between the two scenarios. (For a further discussion see Section VIII.C. - Investigation and Analyses of Dam Break Floods).

Describe how the inundation boundaries were plotted. As a minimum, show on the map and/or in a table the peak discharge, maximum inundation elevation and the travel time (in hours and minutes) of the leading edge and peak of the dam break flood wave to critical locations.

The map should be developed at a scale sufficient to be used for identifying downstream inhabited areas within the area subject to possible danger. Inundated areas should be clearly identified. It may be appropriate to supplement the inundation maps with water surface profiles showing the elevation prior to failure, the peak water surface elevation after failure, and the location of structures at critical locations.

A narrative description of the areas affected by the dambreak can be included to clarify unusual conditions. It should describe the specific area threatened and include information on the size and depth of expected flooding relative to known landmarks and historical flood heights. Whenever possible, major streets, railroads, and other well known features should be used, using local names or terms.

The best available topographic map should be used. The expected inundation following the assumed failure should be delineated on the map. The lines delineating the inundated area should be drawn in such thickness or form (solid line, dashed line, dotted line) as to readily identify the inundation limits as the main features of the map but not bold enough to obliterate houses or other features which are to be shown as being inundated by the flood waters. Clarity is important. When plotting inundation limits between cross sections used for analysis, the lines should reasonably reflect the change in water levels with consideration given to topographic patterns and both natural and manmade features. When inundation lines enter the area of an existing lake or reservoir, they should be so drawn as to represent an increase in the water level of such lake or reservoir. Should this increased water level overtop the dam, the appropriate inundation lines should be drawn downstream of such dam to represent expected inundation in the downstream channel up to a point where an increase in water level will no longer represent danger to life or property. The area between the inundation lines representing the water level may be shaded and or colored to distinguish the area of inundation. Care should be taken to select a shading or colors which will not obliterate the background information shown on the map.

The accuracy and limitation of the information supplied on the inundation maps and how best to use the maps should be described. Since local officials are likely to use the maps for evacuation purposes, a note should be included on the map to advise that, because of the method, procedures, and assumptions used to develop the flooded areas, the limits of flooding shown and flood wave travel times

are approximate and should be used only as a guideline for establishing evacuation zones. Actual areas inundated will depend on actual failure or flooding conditions and may differ from areas shown on the maps. The licensee should review the inundation maps with the local jurisdictions to explain the contents of the inundation maps. The licensee and local jurisdictions should discuss the mapping and any suggested modifications should be made so that both parties fully understand the information contained on the maps.

If inundation maps are to be shown on several pages, a map index should be included to orient the individual pages.

Inundation maps should be updated periodically to reflect changes in downstream areas.

Include any other pertinent information as a result of coordination with the appropriate emergency management authorities. Emergency management agencies may request the inundation maps highlight evacuation routes and emergency shelters.

VIII. Appendices

Following the main body of the EAP (the basic EAP) an appendix section should be included that contains information that supports and supplements the basic EAP.

Listed below are some of the specific topics that should be covered in the appendices accompanying the EAP:

- Investigation and Analyses of Dambreak Floods
- Plans for Training, Exercising, Updating, and Posting the EAP
- Site Specific Concerns
- Approval of the EAP

Each of the these topics are described in detail below:

A. Investigation and Analysis of Dam Break Floods. The EAP appendices should identify and briefly describe the method and assumptions selected to identify the potentially inundated areas.

Several factors usually have to be evaluated whenever dam failures are postulated. The type of dam and the mechanism which could cause failure require careful consideration if a realistic breach is to be assumed. Size and shape of the breach, time of breach formation, hydraulic head, and storage in the reservoir contribute to the dam failure hydrograph. Most of the methods for estimating dam break

hydrographs require the selection of these parameters. There are also several available procedures for routing dam failure hydrographs to determine information on areas inundated by the flood as it travels downstream.

Several different assumptions on inflow conditions should be made regarding the appropriate conditions prevailing at the time of a dam failure in order to ensure that the EAP includes all communities that need to be notified. A "fair weather" (often referred to as "sunny day") dam failure (reservoir at normal full pool elevation, normal stream flow prevailing) is generally considered to have the most potential for loss of human life, primarily due to the element of surprise. A failure at the inflow design flood is considered to show the upper limit of inundation.

Since emergency management agencies may use the inundation maps to develop their evacuation procedures, both the "fair weather" breach and a failure during the flood level approaching the inflow design flood (IDF) should be analyzed and shown on the inundation map. If inundated areas for the "fair weather" breach and the IDF breach are essentially the same or are too close to be shown separately on the inundation maps, then a single inundation area for the two breach conditions may be shown.

Many methods for developing the dam failure hydrograph and routing dambreak flows downstream are available. Many Federal agencies have developed dambreak computer programs that are available upon request. They may be obtained from the National Weather Service, Bureau of Reclamation, Soil Conservation Service, Corps of Engineers, Tennessee Valley Authority, Geological Survey, and Federal Emergency Management Agency. The dambreak model developed by the National Weather Service (NWS) is the most widely used and preferred.

Sensitivity analyses are recommended in order to fully investigate the effect of a failure on downstream areas. Usually, an assumed failure during "sunny-day" conditions results in the worst-case condition for EAP planning purposes since a failure during flooding conditions, when people are "on-alert", will usually require no changes to the notification flowchart. When it is not obvious whether the same notification list would be appropriate for a failure during major flood conditions, the sensitivity analysis should be performed. The sensitivity analysis should vary key assumptions to identify their effect on various failure scenarios in order to select the most appropriate failure mode for developing the EAP. The sensitivity analysis is included for two primary reasons:

1. A sensitivity analysis should be performed when it is not obvious that failure during a "sunny-day" condition would constitute the worst-case condition. For example, situations occur where failure during a "sunny-day" condition will not result in a hazard to downstream life and property. In this situation, a failure during flood flow conditions should be investigated to determine if notification procedures are necessary in the event of an emergency. In addition, if a failure during a flood condition will result in a different notification list or priority of notification from that considered appropriate for a "sunny-day" failure, the EAP should be modified

accordingly. This condition often occurs in sparsely populated areas. A sensitivity analysis is necessary in this case to ensure that all structures that could realistically be impacted are included on the inundation map and all necessary local officials are included in the notification procedures. However, as indicated above, in many cases only one failure scenario, whether it be a "sunny-day" failure or a failure during a flood condition, requires analysis since the notification list and the priority for notification usually remains the same regardless of the antecedent condition investigated. In all cases, practical considerations should govern in conducting dambreak analyses since the ultimate goal is to develop the best workable EAP.

2. A sensitivity analysis is also necessary when a licensee/exemptee/applicant for license desires to demonstrate that a failure under any foreseeable failure scenario would not constitute a hazard to life and/or property, and an exemption from EAP requirements may be justified. In requesting such an exemption, a supporting sensitivity analysis is required.

The need to consider the domino effect should be made on a case-by-case basis. If the assumed failure of a dam would cause the failure of any downstream dams, the licensee has the responsibility to consider the domino effect in its routing of the floodwave downstream. The flood wave should be routed to the point where it no longer presents a hazard to downstream life or property, which includes downstream dams. Therefore, the owner, after assuming a hypothetical failure of its dam, should make an engineering judgement regarding the potential for failure of the downstream dams from the flow condition under consideration or as a result of the failure of the dam being investigated to determine whether it would be prudent to consider failure of any downstream dams during the routing of the dambreak flood wave.

B. Plans for Training, Exercising, Updating, and Posting the EAP. Plans should be developed for the annual training of project operators and other responsible personnel, for conducting periodic EAP exercises, for ensuring timely updating of the EAP, and for posting the Notification Flowchart. New personnel should be trained immediately when they become responsible for EAP activities.

1. Training

Training of people involved in implementation of the EAP should be conducted to ensure that they are thoroughly familiar with all elements of the plan, the availability of equipment, and their responsibilities and duties under the plan.

Technically qualified personnel should be trained in problem detection and evaluation and appropriate remedial (emergency and non-emergency) measures. This training is essential for proper evaluation of developing situations at all levels of responsibility which, initially, is usually based on onsite observations. A sufficient number of people should be trained to ensure adequate coverage at all times.

A training plan could be included in the appendices to the EAP. Exercises simulating emergency conditions are excellent mechanisms for ensuring readiness. Cross-training in more than one responsible position for each individual is advisable in order to provide alternates. A careful record by roster should be kept of training completed and refresher training conducted.

2. Exercising.

A proposed exercise schedule and the plans for the EAP exercise program should be included in this portion of the appendices. It should also discuss plans for conducting a critique of the exercise (both annual drills and periodic comprehensive exercises) and plans for updating the EAP based on the comments from the critique.

This section should also include a form that can be used to document actions taken during any actual emergencies.

The state of training and readiness of key personnel responsible for actions during an emergency should be a part of any exercise to make sure that they know and understand the procedures to be followed and actions required.

Any special procedures required for night time, weekends, or holidays should be included. The exercises should involve an annual drill, as well as periodic tabletop and functional exercises. Testing of remote sensing equipment at unattended dams should be included.

Coordination and consultation with state and local emergency management officials and other organizations when developing a comprehensive EAP exercise program is important in order to enhance the realism of the exercises. Their involvement will greatly improve the close coordination necessary for a successful execution of emergency procedures during an actual emergency. The exercises should include participation by both the licensee and the affected state and local emergency management officials. The exercises should be evaluated both orally and in writing and the EAP should be revised to incorporate the suggested improvements.

3. Updating.

All aspects of the EAP are subject to periodic review and updating in accordance with the Guidelines and the specific and detailed instructions contained in Section 12.24 (a), (b), and (c) of the Commission's Regulations. Although a licensee must conduct a review of the adequacy of the EAP at least once a year, additional exchanges of information between the licensee and all parties involved with the EAP is necessary. Information exchanges, such as an informal phone call, will assure that personnel changes, phone number changes, or changes in emergency response duties are promptly detected with interim changes made to the EAP. All parties should be notified of any changes to the EAP. During the yearly review, the licensee should

assure that project personnel are familiar with site-specific concerns identified in the EAP and determine if any new developments or other changes suggest that revisions should be made to the current EAP (including inundation maps). It is imperative that the licensee furnish the Regional Director and all other holders of the EAP updates to the EAP immediately upon becoming aware of necessary changes to keep the EAP workable. This includes revisions when phone numbers and/or names change for Regional Office contacts.

The licensee must also annually furnish the Regional Director with a statement that the EAP has been thoroughly reviewed and the date it was last tested, with inclusion of any needed revisions and updates or a statement that no revisions and updates are needed. Provide all plan holders copies of all revisions. Mark pages "Revised MO/DA/YEAR" and highlight revised material.

4. Posting of the Notification Flowchart.

An up-to-date copy of the Notification Flowchart should be posted in prominent locations at the dam site and local emergency operations center (essential for unattended dams), as appropriate.

The flowchart should be posted at appropriate phones and radio transmitters at the dam, powerhouse (if applicable), and any other desirable locations. The locations of the posted flowcharts should be indicated in the EAP. Posting requirements for cellular phones present a unique problem. If cellular phones are to be used in an emergency, all users should be familiar with the locations of the flowchart or "pocket" sized, or other convenient form, flowcharts should be carried by all cellular phone users.

A copy of the complete, up-to-date EAP should also be available to personnel at the dam and to local officials. The location of each copy should be stated in this section of the EAP. Consideration should also be given to having a copy of the EAP at the residences of key personnel.

C. Site Specific Concerns. Each dam and downstream area is unique. As a result, each EAP is unique. This section of the appendices should provide a discussion of any site specific concerns that provide valuable information affecting the EAP. The EAP should emphasize where appropriate structural drawings, flood data, etc. are maintained on-site. Quick access to this information is crucial during emergency events.

D. Documentation.

1. Provide the most recent documentation of consultations with Federal, State and local agencies, including public safety and law enforcement bodies. Only the most recent documentation should be maintained in the EAP. Copies of the actual documentation sheets should be submitted to the Commission. All other copies of the EAP need only contain general statements pertaining to the documentation (e.g. a list of agencies involved, a statement that up-to-date documentation is on file, a statement that necessary coordination meetings have been held, etc.). Provide letters of acknowledgment from the contacted agencies.
 - C Letters should indicate that each agency involved understands its responsibility for alerting and/or evacuating the public in those areas within its jurisdiction.
 - C Documentation should be updated on an annual basis to ensure that all participants have received the updates to the EAP and have the most up-to-date EAP on file.
2. Provide letters or memoranda of contact.

- C Coordination is essential to ensure that local officials responsible for warning and evacuation of the public comprehend and accept their individual and group responsibilities. Participation in the preparation of the plan will enhance their confidence in the plan and in the accuracy of its components. Coordination will provide opportunities for discussion and determination of the order in which public officials should be notified, identification of backup personnel, alternate means of communication, and special procedures for periods of darkness, inclement weather, non-business hours, etc. Differences in procedures for notification for different emergency situations should be coordinated prior to finalizing the notification plan(s).

- C Advance preparations should include arrangements for such meeting(s) as are necessary with local and county governments, law enforcement officials, and other public officials who will be responsible for the warning and the evacuation of the occupants of the affected areas. The licensee should discuss the accuracy of the inundation maps or other means used to delineate the affected areas. Times available for response should also be discussed. Public officials to be notified and their priority of notification should be established. Special procedures should be developed for periods of darkness, inclement weather, and non-business hours.

- C All positions critical to the execution of the emergency action plan should be covered 24-hours a day, 7-days a week. Alternative or backup personnel should be identified for all public officials to be notified. Alternative means of communication should be identified.

- C Describe the coordination efforts. Include all letters directed by you to agencies or others and memoranda of meetings or conferences held.

E. Approval of the EAP. The EAP should include a section that is signed by all parties involved in the plan, where they indicate their approval of the plan and agree to their responsibilities for its execution. Including approval signatures helps to assure that all parties are aware of and understand the EAP and agree to their assigned roles, should an emergency occur.

6-4 EAP EXERCISES

6-4.1 General

An annual drill (exercise) is required to be conducted to test the state of training and readiness of key licensee personnel responsible for actions during an emergency. Therefore, more comprehensive, in-depth exercises of EAP procedures will periodically be required in order to include active participation by State and local emergency preparedness agencies and licensee's personnel. The purpose of an in-depth exercise designed to test an EAP is to improve operational readiness and develop the

cooperative spirit and coordination required between the licensee and the emergency preparedness agencies. The exercise will not only reveal the strengths and weaknesses in the EAP itself, but may also, among other things, reveal gaps in available resources, improve coordination requirements, clarify roles and responsibilities, improve individual performance, and achieve public recognition of the EAP. The licensee should also request that the local emergency response agencies notify them immediately of any changes of key personnel.

6-4.2 Annual Drill

Each licensee is required to conduct an annual exercise known as the "in-house drill" to test the state of training and readiness of key licensee personnel responsible for actions during an emergency to ensure that they are fully cognizant of the procedures and actions required during an emergency. **The licensee must conduct an annual drill for each of its EAPs. It is acceptable for an annual drill to concurrently test the EAP for several dams when an overlap in notification is involved. Regional personnel should ensure that these drills are completed. If a licensee does not complete its annual drill, the Regional Director should request that a firm date be submitted for the next and subsequent drills at least 60 days prior to that drill.**

The drill should simulate an emergency condition. The licensee staff member responsible for conducting the test should first develop a realistic scenario under which the EAP would be implemented. Preferably, the scenario should be varied from year-to-year. Any special procedures required for nighttime, weekends, and holidays should also be considered when developing the scenario. Testing of remote sensing equipment at unattended dams should be included. In addition, different levels of notification of internal hierarchy should be tested each time an emergency drill is conducted.

Coordination and consultation with local government, law enforcement officials, and other organizations involved is desirable. This will enhance the realism of the drill and will ensure that telephone numbers on the notification list are accurate. Licensees should be encouraged (not required) to consider the merits of a surprise in-house drill versus a planned one. Of course, the licensee at the time it implements a "surprise" drill should advise its employees that the drill is a test and not an actual emergency. While a planned drill will allow participants to rehearse their roles in the EAP, a surprise drill can be more educational, because of the probability of exposing more basic flaws in the EAP.

Immediately following the drill, the licensee should assess (evaluate) the results with all involved parties. The responses to the emergency scenario at all levels should be reviewed. The purpose of the critique is to identify deficiencies in the EAP, including notification, priorities, responsibilities assigned, etc.

After the critique has been completed, the EAP should be revised and the revisions disseminated to all involved parties. **The licensee must furnish the Regional Director within thirty days of the date of the drill, a critique of the drill and any revision or updates to the EAP as**

a result of the drill. The critique must also include a list of the lessons learned. A report should be filed with the Regional Director even if the evaluation reveals no deficiencies.

6-4.3 Comprehensive Exercises

The involvement of State and local emergency preparedness officials in an exercise to test an EAP is necessary to perfect the close coordination and cooperation that is necessary for a successful execution of an EAP in an actual emergency.

Briefly stated, the licensee has the responsibility to provide warning and notification of a dam failure to the agencies, and the emergency preparedness agencies have the responsibility to provide for evacuation of the affected areas. The licensee must assume that if an emergency preparedness agency is notified of an emergency, the agency will respond appropriately. However, to ensure that everyone carries out their responsibilities, coordination, training and practice are necessary ingredients of a workable EAP.

The comprehensive exercise is intended to bridge the gap between the warning and notification issued by the licensee and the evacuation response of the emergency preparedness agencies. It is important that both the licensees and emergency preparedness agencies understand the total picture so that both parties can make the necessary changes to their plans. This will result in a smooth, confident response should an emergency situation occur.

An exercise, as defined by FEMA in its **Guide to Emergency Management Exercises, SM 170.2, January 1989**, is "an activity designed to promote emergency preparedness; test or evaluate emergency operation, policies, plans, procedures or facilities; train personnel in emergency management duties; and demonstrate operational capability." The comprehensive, in-depth exercise that the FERC requires is an exercise that tests, among other things, the licensee's warning and notification procedures, the State and local agencies response to the notification, their knowledge of the EAP inundation maps, and the cooperative spirit of the licensees and emergency preparedness agencies in a stress-induced environment.

FEMA has identified five elements, or types of exercises, that constitute an exercise program, with each one building on the concepts of the previous exercise. It is not a requirement that every exercise program include all five exercises. However, it is advisable to build an exercise program upon competencies developed from simpler exercises to achieve greater success with the more complex exercises. This means that emergency exercises should be developed and conducted in an ascending order of complexity. Also, **sufficient time should be provided between each exercise to learn and improve from the experiences of the previous exercise prior to conducting a more complex exercise.** The five exercise types, listed from simplest to most complex are:

A. Orientation Seminar

This exercise is a seminar that involves bringing together those with a role or interest in an EAP (i.e. licensee and state and local emergency management agencies) to discuss the EAP and initial plans for an annual drill or more in-depth comprehensive exercise. The seminar does not involve an actual exercise of the EAP. Instead, it is a meeting that enables each participant to become familiar with the EAP and the roles, responsibilities, and procedures of those involved. An orientation seminar can also be used to discuss and describe technical matters with involved, non-technical personnel.

B. Drill

A drill is the lowest level exercise and tests, develops, or maintains skills in a single emergency response procedure. The in-house drill performed by licensees to test the validity of telephone numbers and operator's responses is a drill. A drill is considered a necessary part of ongoing training.

C. Tabletop Exercise

The tabletop exercise is a higher level exercise than the drill. The tabletop exercise involves a meeting of the licensee and the state and local emergency management officials in a conference room environment. The format is usually informal with minimum stress involved. The exercise begins with the description of a simulated event and proceeds with discussions by the participants to evaluate the EAP and response procedures and to resolve concerns regarding coordination and responsibilities.

D. Functional Exercise

The functional exercise is the highest level exercise that does not involve the full activation of the licensee and state and local emergency management agency field personnel and facilities or test evacuation of residents downstream of the dam. It involves the various levels of the licensee and state and local emergency management personnel that would be involved in an actual emergency. The functional exercise takes place in a stress-induced environment with time constraints and involves the simulation of a dam failure and other specified events. The participants "act-out" their actual roles. The exercise is designed to evaluate both the internal capabilities and responses of the licensee and the workability of the information in the EAP used by the emergency management officials to carry out their responsibilities. The functional exercise also is designed to evaluate the coordination activities between the licensee and emergency management personnel. Section 6-4.5 of this chapter lists several functions that should be included in a functional EAP exercise.

The FERC will periodically be requiring, as a minimum, that a functional exercise of an EAP be conducted by a selected number of licensees. A particular licensee should plan on being requested to conduct a functional exercise about once every five years. It should be noted that the functional exercises will be conducted on a licensee basis. Therefore, a licensee should not be expected to

conduct a test more than once every five years for one of its projects. Unless there is good reason, licensees will be requested to choose a different project for EAP testing during each five year cycle. Of course, licensees with one or two projects will have to test the same EAPs.

E. Full Scale Exercise

The full scale exercise is the most complex level of exercise. It evaluates the operational capability of all facets of the emergency management system (both licensee and state and local emergency management agencies) interactively in a stressful environment with the actual mobilization of personnel and resources. It includes field movement and deployment to demonstrate coordination and response capability. The participants actively "play-out" their roles in a dynamic environment that provides the highest degree of realism possible for the simulated event. Actual evacuation of critical residents may be exercised if previously announced to the public.

Both the functional exercise and the full scale exercise are considered to be "comprehensive exercises."

For a detailed explanation of how to develop, conduct, evaluate, and follow-up an effective tabletop, functional, and full-scale exercise, the licensee should attend the FEMA EAP Exercise Design Course or the FERC EAP Exercise Design Course, held annually throughout the country. Summary information on the three (3) higher level exercises has been extracted from the FEMA manuals and is included below for convenience, with minor changes to address FERC's specific needs:

6-4.3.1 Tabletop Exercise

A tabletop exercise includes low stress, little attention to real-time, lower level of preparatory effort, and only rough attempts to simulate reality. The focus is on training and familiarization with roles, procedures, responsibilities, and personalities of the licensee and the emergency management agencies.

The methodology of tabletop exercises is by an open-ended discussion in a meeting format through a facilitator. The discussion is allowed to be interrupted by questions and participant comments. The effectiveness is determined by feedback from participants and the impact this feedback has on evaluating and revising policies, plans and procedures.

There is no utilization of equipment or deployment of resources. Therefore, all activities are simulated and participants interact through discussion. A "narrative" (or scenario) sets the scene for the simulated event. It briefly describes what has happened and what is known up to the time of the exercise. A sophisticated form of the tabletop exercise provides the participants with "messages" as a stimulus for responses. The "messages" communicate detailed events to the participants as the exercise progresses. The purpose of the "messages" is to provide sufficient information to the participants so that they will respond with an action or a decision. New (or updated) messages are interjected throughout the

exercise to evoke responses. The flow of the exercise depends on the quality of the messages and upon their precise timing in the exercise.

The advantages of a tabletop exercise are that there is modest commitment in terms of time, cost and resources. It provides an effective method of reviewing plans, implementing procedures and policies, and it serves as an educational device to acquaint the licensee and key agency personnel on emergency responsibilities and procedures. It also acquaints licensee and emergency response personnel with each other on a personal basis.

The disadvantages of a tabletop exercise are that it lacks realism, and does not provide a true test of participants' capabilities. It provides only a limited exercise of plans, procedures, and participants' staff capabilities.

A facilitator (or controller) will monitor the pace and flow of a tabletop exercise by introducing the scenario narrative and messages into play. Facilitators may also include individuals from the licensee's organization and the emergency preparedness agencies. The facilitator must be able to stimulate discussion, making sure that no one participant dominates the exercise. The facilitator leads the conduct of a tabletop exercise and makes sure every participant responds to at least one message during the exercise.

The process of developing a tabletop, functional, or full scale exercise involves similar steps which largely differ in the level of complexity and realism desired. This involves **assessing the needs** for an exercise, **defining the scope** of an exercise, writing a **statement of purpose**, writing **objectives**, writing a **narrative**, and writing **problem statements** (tabletop) or **messages** (functional and full scale). Greater realism and attention to detail are necessary for the development of the functional exercise than for the tabletop, with an even greater amount of detail needed for the full scale exercise. These steps are briefly discussed below, with allowances needing to be made as to the level of detail desired in relation to the type of exercise being designed.

The first step in the process of developing an exercise is to **assess the needs** of the exercise by identifying those areas most in need of an exercise.

In **defining the scope** of an exercise, six components need to be addressed in the developmental stage: (1) the types of licensee and emergency management agency activities or procedures you want to exercise; (2) the parties to be involved; (3) the kinds of personnel involved; (4) the degree of realism desired; (5) the hazard or the selection of a high priority problem; and (6) the geographical area where the problem could occur.

The **statement of purpose** is then developed. It should clearly and concisely explain why the exercise is being conducted. At this point, the exercise should be announced, the necessary coordination should be accomplished, and the date and location should be established.

The next step in developing an exercise is writing **objectives**; that is, defining what should be accomplished by conducting the exercise. The needs assessment, scope, and purpose statement should be examined very closely during objective writing to address expected benefits of the exercise and what emergency actions are to be exercised. Exercise objectives should be specific and realistic, yet challenging, results-oriented, and measurable.

The next step is to prepare a **narrative**. A narrative (or scenario) is a short written story that sets the scene for the exercise. The job of the narrative is to get the exercise participants into the exercise as if they were confronting a real situation. Simply put, the narrative is an account composed of a few paragraphs that provides background information to the exercise participants. The narrative should be written so that it helps participants to understand the exercise and reflect a sense of concern, urgency, and excitement.

While setting the scene for the simulated emergency and providing some specific information, the narrative should NOT provide participants with ALL the information necessary to respond to a situation. Participants will gather additional details during the exercise as the events unfold. Obviously, the narrative should NOT suggest possible responses to the simulated emergency.

The last step of exercise development is the preparation of a major sequence of events list, a detailed sequence of events list, and **problem statements** (for a tabletop) or **messages** (for a functional or full scale exercise). The exercise narrative provides the participants with only a certain amount of information. The **major sequence of events list** itemizes the events from the beginning of the exercise to the conclusion that will require a response by the licensee or the emergency preparedness agencies. The major events can be developed from the statement of purpose. The detailed sequence of events lists the details for each major event. **The messages or problem statements are developed from the major and detailed sequence of events list.** Details of the exercise are transmitted to the participants through the messages or problem statements. These provide sufficient information to the participants so that they will be able to respond with an action or decision.

Once these steps are completed, the exercise can proceed. The flow of the exercise depends on the quality of the messages and upon their precise timing in the exercise. A facilitator (for a tabletop) or a controller (for a functional or full scale) monitors the flow of the exercise and supervises the input of messages. A simulator creates the simulated emergency by sending pre-scripted messages and/or spontaneous messages to players.

Once the exercise is completed it is necessary to evaluate the results of the exercise. A realistic exercise provides the best opportunity to evaluate the emergency action plan and overall preparedness to operate under emergency conditions. The extent and depth of the evaluation to be undertaken is determined by the participants. Controllers' and participants' evaluations and observations are required along with additional analysis by FERC observers.

The purposes of evaluating an exercise are to identify needed improvements in the EAP, identify needed improvements in the emergency management system and the licensee's organization, identify needed training/personnel deficiencies, observe whether the exercise has achieved its objectives, and identify areas requiring additional coordination.

The outcome of an exercise consists of individual improvement through training and EAP improvement through follow-up. Without evaluation, needed improvements will not be identified, improvements will not be made, and the exercise will not be as worthwhile.

Evaluation begins in the early stages of exercise development when the objectives are planned. If the objectives involve resource allocation by licensees or agencies, then it will be necessary to evaluate communication between the licensees and agencies and the final resources allocated.

An immediate post-exercise critique should be held, followed by a more detailed evaluation report. A critique is a debriefing of the participants. It is a time to gather and share information about what happened during the exercise, to describe what went right, and identify what went wrong. The critique should be both oral and written.

The oral critique is a group discussion led by one or more controllers. To minimize the defensiveness of the participants and maximize the sharing of information, the oral critique should be structured to give each participant an opportunity to share their observations and to encourage the participants to report on both what went well and what went poorly. Each participant should typically be allotted a reasonable length of time to present their observations in order to prevent one participant from monopolizing the discussion. Having both oral and written critiques strengthen the evaluation report data.

The formal evaluation of exercise performance consists of a brief written report that is based on observations and recommendations that come out of the critique, as well as the reports of the designated evaluators. Data needed for an evaluation report include one's own observations, the participants' debriefing comments, the participants' written critique, comments from controllers and/or simulators, any subsequent clarification or discussion with participants, and exercise plans, objectives, expected actions, and procedures. Licensees should prepare the written report.

Follow-up is the final and critical stage of the exercise process and follow-up recommendations are the purpose of the evaluation report. Follow-up is the process of implementing the recommendations.

6-4.3.2 Functional Exercise

The functional exercise is intended to test or evaluate specific capabilities of the participants. As discussed in Section 6-4.3.1, the Tabletop Exercise focuses on training and familiarization with roles, procedures, responsibilities, and personalities. Therefore, the tabletop exercise provides an opportunity to ask questions about the narrative, messages and the appropriateness of participants' responses. It is an opportunity to discuss and establish appropriate responses to the situation. The functional exercise tests and evaluates the reactions and responses of the participants in a stress induced environment with time constraints. Whereas a tabletop exercise provides opportunities throughout the exercise to stop and discuss what actions and responses would be appropriate, the functional exercise is a time constrained test with limited opportunity for discussion. The functional exercise simulates actual emergency situations and participants' responses without field deployment. Therefore, the exercise should be conducted with the participants in one location or with the participants located at their own facilities, with communications through expected emergency communication links. Those responses are not evaluated until the conclusion of the exercise.

The functional exercise is based on a simulation of an emergency that includes a description of the situation (narrative), a master sequence of events list (MSEL), a timed sequence of messages, and communication between participants and simulators. If possible, the licensee should encourage the activation of the emergency operations center (EOC) at the State or local level, as appropriate, so that the EOC members can practice a coordinated, effective response in a time-pressured, realistic emergency situation. Licensee, individual, agency, and system performances are evaluated during the exercise. A functional exercise can involve policy, coordination, and operational response personnel of the licensee and the effected community.

A functional exercise is designed to evaluate the response, the organizational, skills, and individual efforts of both the licensee and local emergency management personnel. Functional areas that can be tested include policy making, planning, decision-making, communication, coordination of resources, management of personnel, and implementation of procedures. That is, it can include any function needed for an efficient response or recovery from an emergency. **See Section 6-4.5 for a list of the five standard functions that should be included as a minimum in the exercise.**

Conducted in a real-time environment (although after the initial hour of the exercise, compressed-time may be necessary), a functional exercise is based on a scenario which comprises a predetermined narrative, events list, and messages developed by an exercise team of one or more individuals. After the initial stages, momentum of the exercise is determined largely by spontaneous interaction among participants and simulators. Scenario-related events and messages of increasing complexity, threat, and pressure are interspersed in an emergency situation designed to test the participants' skills, knowledge, awareness, and ability to respond under simulated conditions. The functional exercise is followed by a critique session that allows participants to evaluate their performance and lessons learned throughout the training exercise.

The purpose of the functional exercise is to exercise the coordination of the licensees and the emergency management agencies under simulated conditions that provide realism and stress. The functional exercise brings together the policy, coordination and operational officials of the licensee and involved emergency preparedness agencies into one area, either a simulated or real EOC. The functional exercise gives the participants a fully simulated experience of being in a major disaster. The functional exercise allows one to assess the direction and control of the disaster management; the decision-making process, communication and information among participants, allocation of resources and staff; overall adequacy of resources to meet the disaster situation; and adequacy of current policies, plans, and procedures. The functional exercise also encourages a spirit of cooperation and coordination between the licensee, the emergency preparedness agencies, and the FERC.

Conducting a functional exercise should be the major goal of every exercise program. It provides the greatest opportunity to observe, assess, and improve the coordination in response to an emergency. The reason that a functional exercise is a general goal of an emergency exercise program is that it offers the opportunity to test a participant's response in a full simulation under "real-life" conditions. Since the functional exercise is a high-level exercise, **it is strongly suggested that orientation seminars, drills and tabletop exercises be conducted prior to the functional exercise.**

The individuals involved in the functional exercise should be those people who are responsible for the coordination and implementation of the EAP. They should be those individuals from the licensee and agencies that would be most active during a disaster.

It is sometimes difficult (because of busy schedules or other commitments) to get policy-level personnel involved in a functional exercise, but their presence is beneficial. The licensee should attempt to involve key personnel so that the appropriate level of importance is understood by management and other personnel. Building the exercise program pays off. If reactions to earlier exercises are good, the policy-level personnel will be more likely to participate in a functional exercise.

The preparation tasks for a functional exercise include developing specific objectives, developing the narrative (or scenario), assuring adequate physical facilities, organizing displays and materials, recruiting and training exercise participants, and planning for the exercise critique and evaluation. The level of complexity needed for the functional exercise should be commensurate with the anticipated site conditions and complexity of the notification procedures.

Because these tasks are so varied and dependent upon each other's completion, it is important to plan this preparation time carefully. Milestones should be established along with responsibilities for each of the major activities of preparation.

Apart from the actual participants in the functional exercise, there are three roles that representatives of the licensee and/or emergency preparedness agencies must fill. These are the exercise controller, exercise simulators, and exercise evaluators.

The controller's responsibilities include monitoring the sequence of events as they unfold, the flow of messages, the overall conduct of the exercise, controlling the spontaneous inputs by simulators, coordinating information among simulators, and responding to unplanned situations.

The simulators' responsibilities include sending pre-scripted messages at the scheduled time, responding to unanticipated actions by participants with spontaneous messages, and maintaining contact with the controller about the progress of the exercise.

The evaluators have the task of observing the actions and decisions of the participants during the exercise and contributing, along with the comments of exercise participants, to the formation of an evaluation report. In particular, evaluators will be looking to see how participants react to the scenario events and messages. Ideally, there should be an evaluation team with representatives from the licensee, agencies, and FERC.

As with the critique for the tabletop exercise (Section 6-4.3.1), the licensee's evaluation report and follow-up to the recommendations in the report are important aspects of the exercise.

6-4.3.3 Full-Scale Exercise

A full-scale exercise adds a field component that interacts with a functional exercise through simulated messages.

A full-scale exercise is intended to evaluate the operational capability of licensee and agency participants in an interactive manner over a substantial period of time. It involves the testing of a major portion of the basic elements existing within emergency action plans and the participants in a stressful environment. Full-scale exercises test the mobilization of personnel and resources and the actual movement of emergency workers, equipment, and resources required to demonstrate coordination and response capabilities.

A full-scale exercise should test a large portion of the expected actions needed by the licensee and agencies to implement the EAP.

Full-scale exercises add an integration and coordination component to the functional exercise. They do not substitute for simulation; instead, they complement it. Events and messages may be complex and detailed. Many of the messages will be pre-scripted and scheduled, while others may be dynamically input by controllers in response to the flow of the exercise.

The major components of a full-scale exercise include adding the field component to the exercise process; testing the deployment of seldom-used resources; involving policy, coordination, operational, and field response personnel and resources; and testing a major portion of emergency action plans, resources, and capabilities.

Full-scale exercises greatly expand the scope and visibility of the exercise program. As a result, a well-done field exercise can result in substantial improvement in public attention and credibility. At the same time, a poorly conducted exercise can create credibility problems for the entire program of emergency action planning. Full-scale exercises should be the culmination of an exercise development program that has grown with the capacity of the participants to conduct exercises. This should also include an ongoing cycle of progressively more in-depth evaluations.

Full-scale exercises draw media and community attention to emergency preparedness; teach by doing; test total coordination, not only among policy and coordination officials, but also field forces; test many licensee and agency emergency management functions at one time; evaluate cooperation; and point out physical resource capabilities. They can be a true test of the total emergency management system and the effectiveness of a specific EAP.

For agencies or local communities, full-scale exercises require considerable preparation and can often be aimed at practical tests of "first-in" responders, including police, fire, and medical personnel. They can be used to test triage (dealing with casualties) procedures, on-scene management of resources, and coordination through field command posts. Careful consideration should be given to selecting the day, date, and time for any exercise. The inclusion of these types of considerations should be left to the agencies since they can best assess the benefits and constraints of doing so.

Because a full-scale exercise requires the mobilization of personnel and resources, careful consideration must also be given to the selection of an exercise site. The primary factor here is one of adequate space, financial capability, and support.

In any exercise, a real emergency might occur, especially during a lengthy full-scale exercise. In planning the exercise, both the licensee and emergency preparedness agencies should ensure there are enough personnel and equipment not involved in the exercise to respond to a real emergency. In some instances, it may be necessary to stop the exercise.

As with the functional exercise, the controller is responsible for assuring that the exercise starts on schedule. Simulators and evaluators should keep a log of all significant events. Also, each participant should log its actions as much as possible. Videotaping the exercise and critique can be beneficial.

A well-designed, full-scale exercise can be used to obtain a great deal of favorable media attention. In fact, a full-scale exercise of any magnitude will draw media attention whether it is sought or not.

Therefore, it is wise to include the media in any exercise plans. They can be extremely helpful in a number of ways, and it will increase realism if they are present.

At the conclusion of the exercise, the critique and evaluation report required by the licensee are important so that necessary follow-up action can be taken.

6-4.4 Role of Licensee

The design of an effective exercise depends on the coordination and cooperation of the licensee, the FERC, and the emergency preparedness agencies. Ideally, the licensee should chair the exercise. It may also be appropriate for an emergency preparedness agency representative, agreed to by the participants, to co-chair the exercise. In other words, the licensee should take the responsibility for coordinating the design of the exercise and holding the exercise. However, the licensee does not necessarily have to serve as the Controller of the exercise, with the responsibility to monitor the flow of the exercise and supervise the input of messages.

As chair, the licensee should oversee the development of the exercise. It has the responsibility to coordinate the schedule for the actual exercise, including the orientation seminars, table top exercises, etc. **The licensee should advise the FERC Regional Director of the plan and schedule for the exercise and date of each aspect of the exercise.**

The functional or full scale exercise should test both the internal and external actions in response to implementation of the EAP. **The primary function of the exercise is to test the response to a dam failure. The licensee, as chair, should ensure that this remains the primary focus of the exercise.**

Therefore, prior to contacting the State and local agencies to coordinate an exercise, the licensee should establish its goals. It should clearly set forth for the agencies the aspects of the EAP that it wants to examine and the level of involvement of the State and local agencies. However, the local agencies may introduce other emergencies that could occur at the time of the dam failure to test their capabilities to respond to several incidents at one time.

The FERC will provide assistance, as necessary. The FERC will participate in the exercise as an observer and will participate in the follow-up critique of the exercise.

6-4.5 FERC Goals and Objectives

A full scale exercise of a simulated emergency is the ideal approach to evaluate every participant's knowledge, understanding, and reaction to a dam failure event. **There are practical considerations that will indicate that full scale exercises may not be appropriate in all cases. Due to the complexity and expense in terms of personnel and equipment**

committal, the full scale exercise will normally be executed at the option of the licensee unless peculiar circumstances of a particular project or lack of confidence in previously performed lower level exercises warrant a request by FERC staff for a full scale exercise. Therefore, the FERC's goal is to have licensees periodically conduct a functional exercise of an EAP.

The FERC will focus primarily on high hazard dams in identifying those projects that warrant a functional exercise. Since a drill is one step in developing the higher level functional exercise, the annual drill should be incorporated into the development of a functional exercise. No separate drill would be required in any year when a functional exercise takes place.

Before a functional exercise can be conducted, it is necessary to lay the groundwork for that exercise. This may require one or more orientation seminars, a drill to verify telephone numbers, and a tabletop exercise, all of which should be scheduled before the planned date for the functional exercise so that there is adequate opportunity to evaluate and improve the EAP. It is suggested that each of these elements be held before the functional exercise is conducted.

Each EAP is unique. Thus, each exercise must be tailored to the EAP being tested. For example, several unique applications to a dam failure event include the verification of failure, the moving or expanding nature of the area in danger, the impacts on timing, the disruption of transportation, areas that will become isolated due to flooding, alarms and sensors to detect a dam failure emergency, and the concern for transients and recreationists. Other complications could include the extent of flooding depending on the conditions at the time of failure, power and communication outages, and failure during times of darkness and on weekends or holidays. In addition, there are site specific concerns and complications that should be considered. The FERC's objective is to ensure that EAPs are periodically reviewed and that each EAP is workable in an actual emergency.

The five standard functions or capabilities of the emergency preparedness agencies should be included in an exercise. Therefore, when approaching agencies with the concept of a functional exercise to test an EAP, the licensee should advise the State and local agencies that it would like the exercise to focus on at least the following areas:

A. Alert, Notification, and Warning

This tests the communication system, the primary and/or alternate back-up systems, the messages to determine if they are appropriate and clearly understood. It verifies the names and phone numbers on the notification list and their order of priority. Remote sensing equipment should be tested at unattended dams at the start of a functional exercise.

B. Direction and Control Function

This tests and evaluates the emergency operations capability and timely response in a stressful environment. It includes the response to health problems, fire, downed power lines and loss of life, including drownings.

C. Evacuation

This is a key issue in the exercise as it tests the participants' understanding of the inundation maps. Experience indicates the inundation boundaries and the road names thereon may not always be clear and fully understood. Maps are often revised as a result of the exercise.

D. Shelters

This reveals those shelters that should not be used because they are in the flood plain or access to the shelters is affected by transportation through the inundation area.

E. Public Information

This tests the capability to issue accurate information for a dam failure event.

The licensee, in discussing these five areas with the State and local emergency preparedness agencies, should provide the agencies with opportunities to identify other areas they believe should be exercised to evaluate their effectiveness to respond to situations unique to a dam failure situation.

6-4.6 Results from an Exercise

The FERC has identified five major results that should be achieved through an exercise:

A. Develop a Spirit of Cooperation

This is to include the licensee, the State and local emergency preparedness officials, and the FERC. Without a cooperative spirit, the EAP program will not be as successful.

B. Exchange of Knowledge

The licensee, the FERC, and the State and local officials will help each party to understand their individual responsibilities and capabilities. It will also provide the opportunity to ensure that all parties clearly understand the EAP, particularly critical matters such as the data presented on the inundation maps. The exercise process should also reveal deficiencies in resources and information available to the licensee and the state and local agencies.

C. Revision to EAPs

An exercise will most likely reveal areas of the EAP that require modification. This should reveal the strengths and weaknesses of the EAP, including specified internal actions, external notification procedures, and adequacy of other information, such as inundation maps.

D. Expenditures

The cost to develop and conduct an exercise, as well as any follow-up action, should be kept to a minimum. Innovative ideas and cost-effective implementation of an exercise, rather than major expenditures, are the intent. Generally, the participants will be expected to pay for their costs in participating in the exercise. If problems arise regarding funding, the Regional Director should be contacted for guidance.

E. Written Critique

As one of the follow-up requirements to the exercise, a written critique, in the form of a formal report, should be prepared by the licensee and submitted to the FERC within sixty days of completing the exercise. See Appendix VI-D for the format that should be followed. Comments from the licensee and the State and local participating agencies regarding their respective participation in the exercise should be included in the critique. The critique should document and evaluate the various aspects of the exercise, including the timeliness of responses and areas of concern. It should include observations and recommendations that result from the exercise, the debriefing comments, the participants' written critiques, any subsequent clarification or discussions, and planned follow-up action with a plan and schedule. The report does not need to be elaborate; it should be clear and concise in the presentation of the information required. **The licensee's report should also include a page summarizing the critique comments and the lessons learned by both the licensee and the participating State and local agencies and a plan and schedule to make the necessary changes.**

It should be remembered that the purpose of the exercise is to identify areas for improvement of the EAP. The licensee will not be held accountable for shortcomings identified exclusively in the state or local agencies' domain.

6-4.7 Availability of Training

The Division of Dam Safety and Inspections (D2SI) of the FERC offers the "Emergency Action Plan Exercise Design Course" at various locations throughout the United States several times a year. This course is tailored for dam owners, and FERC licensees specifically. The course includes an invited speaker from a FERC-licensed project to provide the "licensee perspective" related to the design of an EAP exercise. The FERC endeavors to also invite other appropriate agencies, such as the National Weather Service, state dam safety officials, and local response agency personnel to contribute to the course instruction. The FERC Regional Offices should be contacted for availability of this course.

The "EAP Exercise Design Course for Dam Owners" developed by FEMA is sufficiently generic in nature so that the knowledge learned about tabletop, functional, and full-scale exercises can be useful for developing an EAP exercise for a simulated dam failure. The course is given nationwide and is

conducted by FEMA in partnership with State emergency management offices. Licensees, as well as Regional Office personnel, are encouraged to attend the course. Licensees should be encouraged to suggest to local officials that they also participate in the course.

The State Training Office in each state periodically conducts an Exercise Design Course. It is suggested that licensees avail themselves of this training. If it is not available in its home State, the licensee should explore the availability of the course in other states. The State Office of Emergency Management should be contacted for dates and other information on the "Exercise Design Course". The FEMA training is currently offered free of charge.

Another source of "hands-on" training is to attend one, or more, tabletop, functional, or full-scale exercises. As licensees develop and conduct their exercises, they are encouraged to invite other licensees as observers. As a licensee observes an actual exercise, it may identify deficiencies in its own plans and will be able to make improvements before it holds its own exercise.

6-4.8 Licensee Initiative

The licensee will have to rely on the State and local emergency preparedness agencies to respond to notification that an emergency has occurred. **Therefore, licensees should take the initiative to hold periodic functional or full scale exercises with the appropriate agencies rather than waiting for a FERC letter requiring them to do so.** After a functional exercise is undertaken and the licensees and agencies make changes to the EAP, although it is not a FERC requirement, **it may be advisable to conduct a follow-up functional exercise the next year or as soon as practicable to verify that the changes to the EAP were adequate.**

6-5 Radiological Emergency Response Plan

Each owner of a hydroelectric project under jurisdiction of the Federal Energy Regulatory Commission located within a 10-mile radius of a nuclear plant licensed to operate shall prepare a radiological emergency response plan to be implemented in the event of a severe accident or incident resulting in the release of radioactive materials. A plan is required if the 10-mile radius includes any project structures such as the dam or powerhouse that are used in changing water flows, or project facilities that would be affected by radioactive materials in such a manner that would interfere with project operations. The plan will be a supplement to the Emergency Action Plan and made a part thereof. It should contain, but not necessarily be limited to:

- A. Detailed procedures for: The evacuation of power plant personnel when advised or directed to do so by the appropriate State or local government official; setting of gate openings; continuation, curtailment or cessation of generation; coordination with, and notification of, customers, power pools, and other interconnected power suppliers; advance coordination with

operators of upstream and downstream reservoirs; and/or other actions as considered appropriate.

- B. A list of State and/or local government officials who are responsible for notification of hydroelectric project personnel that nuclear accident or incident is developing (or has occurred). This part of the plan should specifically identify the State or local government officials responsible for notifying individual(s) in the hydroelectric power plant owner's organization. It should also include provisions for keeping the owner's key personnel currently informed on the developing situation to allow timely action or response at the affected hydroelectric project. This portion of the plan should identify, if other than the officials noted above, the State or local government agency representatives authorized to direct or advise implementation of action, such as evacuation of the area, or other appropriate action.
- C. Notification plans should be developed for alerting the following concerned individuals of proposed plan implementation. Reference can be made to the notification procedures contained in the main body of the emergency action plan if appropriate.
 - 1. Local, State, and Federal government officials, including the FERC Regional Director or alternate.
 - 2. Operators of water-related facilities.
 - 3. Residents and owners of properties that could be endangered by the change in project operation.
 - 4. Supervisors and other company officials.

The Radiological emergency response supplement to the emergency action plan shall be posted with the main body of the emergency action plan in a prominent location accessible to operating and supervisory personnel. Such personnel shall be familiar with their responsibilities under the plan. Training of these personnel shall be conducted to assure adequate and timely performance of their duties in the event of an emergency.

As with the other parts of the emergency action plan, all aspects of the plan are subject to continuous review and updating. At least once a year, a comprehensive review shall be made of the plan. Any revisions shall be made after consultation with Federal, State, and local agencies, and electric power producers and users, as appropriate. The need for an update shall be reported to the Regional Director no later than December 31, of each year.

The affected owner will be requested to file a plan no later than 3 months after the date of issuance of a license to operate a nuclear plant.

If the Regional Director determines that an emergency action plan is not required for the hydroelectric project, the radiological supplement shall, nevertheless, be filed. Evidence of coordination with the State or local director of civil defense, or the appropriate official responsible for emergency preparedness, should be obtained and forwarded with the plan. Three copies should be submitted to the Regional Office.

6-6 EAP at a Government Dam

When a project is located at a Federal dam, the licensee is to cooperate with the appropriate Federal agency in any emergency action planning which would provide procedures to be followed the case of an accident to or failure of water retaining structures or other structures under Commission jurisdiction that may affect the integrity and/or operation of the Federal project. Therefore, a documented procedure must be prepared for notifying the appropriate representatives of the Federal agency of an emergency and should ensure that the operating personnel are familiar with these procedures. The EAP is to include the requirement that the Commission's Regional Director is notified of the occurrence of an emergency situation. Also, the procedure should discuss the licensee/exemptee's responsibilities and plans to act under any EAP formulated by the Federal agency for that government facility. Three copies of the procedure for notifying the Federal agency as well as a written statement, verified in accordance with Section 12.13 of the Commission's regulation, indicating that the licensee/exemptee will cooperate in the implementation of that Federal agency's EAP and that it has instructed its operating personnel on how to respond to an emergency under the Federal agency's plan. The notification procedure is subject to the requirements for training, exercising, updating and posting described on pages 6-38 through 6-40; Section VII (Appendix B) of the Guidelines.

6-7 APPENDICES

APPENDIX VI-A

DAMBREAK BREACH PARAMETERS

NOVEMBER 1998

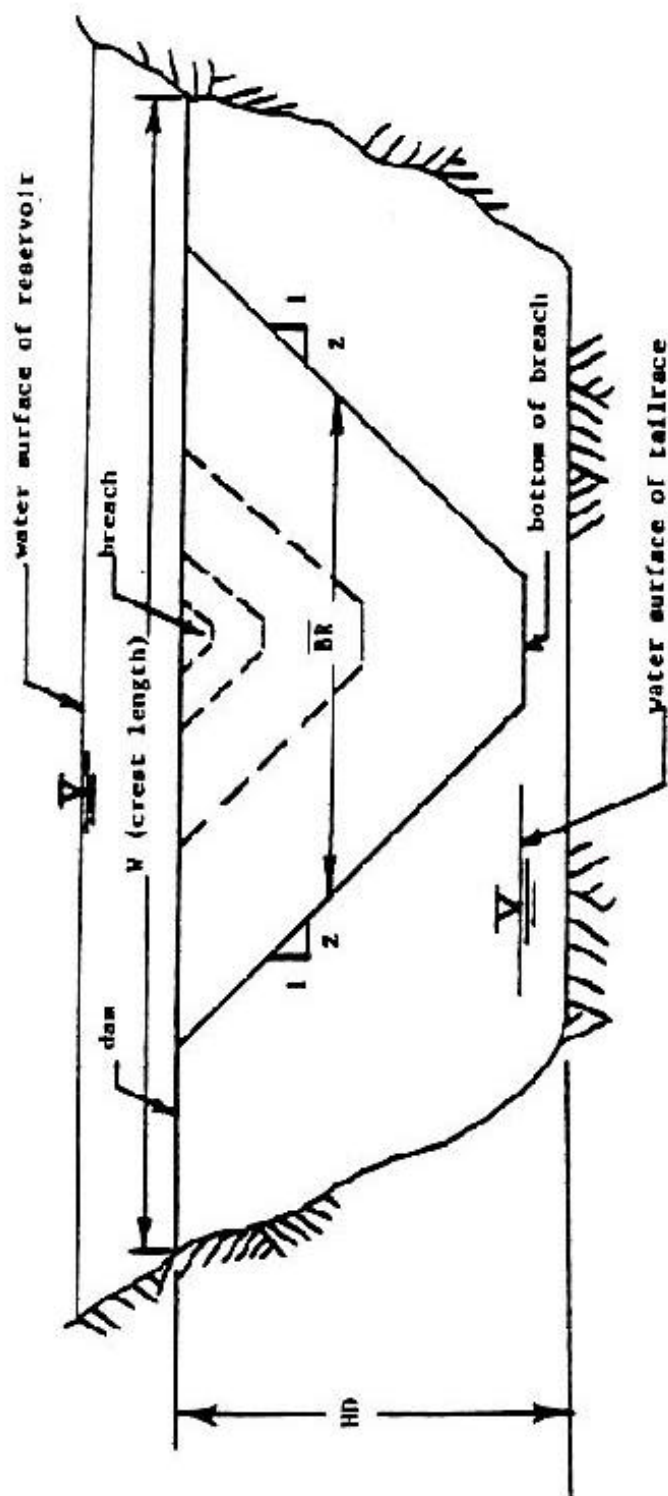


FIGURE 1. DEFINITION SKETCH OF BREACH PARAMETERS

Comments:

1. \overline{BR} is the average breach width, which is not necessarily the bottom width. \overline{BR} is the bottom width for a rectangle, but \overline{BR} is not the bottom width for a trapezoid.
2. Whether the shape is rectangular, trapezoidal, or triangular is not generally critical if the average breach width for each shape is the same. What is critical is the assumed average width of the breach.
3. Time to failure is a function of height of dam and location of breach. Therefore, the longer the time to failure, the wider the breach should be. Also, the greater the height of the dam and the storage volume, the greater the time to failure and average breach will probably be.
4. The bottom of the breach should be at the foundation elevation.
5. Breach width assumptions should be based on the height of the dam, the volume of the reservoir, and the type of failure, (e.g. piping, sustained overtopping, etc.).
6. For a worst-case scenario, the average breach width should be in the upper portion of the recommended range, the time to failure should be in the lower portion of recommended range, and the Manning's "n" value should be in the upper portion of the recommended range. If a worst-case scenario is not used, a sensitivity analysis should be performed to fully investigate the impacts of a failure on downstream areas since the actual breach parameters will not be known. The sensitivity analysis will provide an estimate of the confidence limits and relative differences resulting from varying failure assumptions.
 - a. To compare relative differences in peak elevation based on variations in breach widths, the sensitivity analysis should be based on the following assumptions:
 1. Assume a probable (reasonable) maximum breach width, a probable minimum time to failure, and a probable maximum Manning's "n" value. Manning's "n" values in the vicinity of the dam (up to several thousand feet or more downstream) should be assumed to be larger than the maximum value suggested by field investigations in order to account for uncertainties of high energy losses, velocities, turbulence, etc., resulting from the initial failure.
 2. Assume a probable minimum breach width, a probable maximum time to failure, and a probable minimum Manning's "n" value.

- b. To compare differences in travel time of the flood wave, the sensitivity analysis should be based on the following assumptions:

1. Use Criteria in a. 1.
2. Assume a probable maximum breach width, a probable minimum time to failure, and a probable minimum Manning's "n" value.

Plot the results of both runs on the same graph showing the changes in travel time with respect to distance downstream from the dam.

- c. To compare differences in elevation between natural flood conditions and natural flood conditions plus dambreak, the sensitivity analysis should be based on the following assumptions:

1. Route the natural flood without dambreak assuming a maximum probable Manning's "n" value.
2. Use criteria in a. 1.

Plot the results of both runs on the same graph showing changes in elevation with respect to distance downstream from the dam.

- d. Investigations under both normal and flood flow conditions should be considered, as appropriate.
7. When dams are assumed to fail from overtopping, wider breach widths than those suggested on Table 1 should be considered if overtopping is sustained for a long period of time.

TABLE 1
SUGGESTED BREACH PARAMETERS
 (Definition Sketch Shown in Figure 1)

Parameter	Value	Type of Dam
<u>Average</u> width of Breach (BR) (See Comment No. 1)	$BR = \text{Crest Length}$	Arch
	$BR = \text{Width of 1 or more Monoliths, usually } BR \leq 0.5 W$	Masonry, Gravity
	$HD \leq BR \leq 5HD$ (usually between 2HD & 4HD)	Earthen, Rockfill Timber Crib
	$BR \geq 0.8 \times \text{Crest Length}$	Slag, Refuse
Horizontal Component of Side Slope of Brach (z) (See Comment No. 2)	$0 \leq z \leq \text{slope of valley walls}$	Arch
	$z = 0$	Masonry, Gravity, Timber Crib
	$\frac{1}{4} \leq z \leq 1$	Earthen (Engineered, Compacted)
	$1 \leq z \leq 2$	Slag, Refuse (Non-Engineered)
Time to Failure (TFH) (in hours) (See Comment No. 3)	$TFH \leq 0.1$	Arch
	$0.1 \leq TFH \leq 0.3$	Masonry, Gravity
	$0.1 \leq TFH \leq 1.0$	Earthen (Engineered, Compacted) Timber Crib
	$0.1 \leq TFH \leq 0.5$	Earthen (Non Engineered, Poor Construction)
	$0.1 \leq TFH \leq 0.3$	Slag, Refuse

Definition: HD - Height of Dam
 z - Horizontal Component of Side Slope of Breach
 BR - Average Width of Breach
 TFH - Time to Fully Form the Breach
 W - Crest Length

Note: See page 6-A-1 for definition sketch

Comments: See Page 6-A-2 - 6-A-3

APPENDIX VI-B

FEMA "EXERCISE

DESIGN COURSE" MANUALS

NOVEMBER 1998

FEMA Publications - Three publications have been prepared by FEMA that provide specific information on how to design and conduct an effective exercise. Those publications, which are excellent source materials and are used in the FEMA sponsored "Exercise Design Course", are titled:

1. **Exercise Design Course, "Guide to Emergency Management Exercises", SM 170.2, January 1989**
2. **Exercise Design Course, "Student Workbook", SM 170.1, January 1989**
3. **Exercise Design Course, "Exercise Scenarios", SM 170.3, January 1989**

APPENDIX VI-C

SAMPLE TITLE PAGE, APPROVAL PAGE

AND

TABLE OF CONTENTS

NOVEMBER 1998

[Title Page]

EMERGENCY ACTION PLAN

[Name] of Development

Project No. [FERC No.]

National Inventory of Dams No.

Name of the licensee/exemptee/applicant for license:

Address:

Submitted [date]

Verification:¹

State of [],

County of [], ss:

The undersigned, being first duly sworn, states that [he, she] has read the following document and knows the contents of it, and that all of the statements contained in that document are true and correct, to the best of [his, her] knowledge and belief.

(Name of Person Signing)

(Title)

Sworn to and subscribed before me this [day] of [month], [year].

(Signature of Notary Public or other state
or local official authorized by law to
notarize documents).

¹The verification form is to be completed only by the licensee, exemptee, or applicant for license that prepared the plan, not by agencies that received copies of the plan.

SEAL

Contents of the Plan

Page No.

- I. Notification Flowchart
- II. Statement of Purpose
- III. Project Description
- IV. Emergency Detection, Evaluation, and Classification
- V. General Responsibilities Under the EAP
 - A. Licensee Responsibilities
 - B. Responsibility for Notification
 - C. Responsibility for Evacuation
 - D. Responsibility for Termination and Follow-Up
 - E. EAP Coordinator Responsibility
- VI. Preparedness
 - A. Surveillance
 - B. Response During Periods of Darkness
 - C. Access to Site
 - D. Response During Weekends and Holidays
 - E. Response During Periods of Adverse Weather
 - F. Alternative Systems of Communication
 - G. Emergency Supplies and Information
- VII. Inundation Maps

VIII. Appendices

- A. Investigation and Analyses of Dambreak Floods
- B. Plans for Training, Exercising, Updating, and Posting the EAP
- C. Site-Specific Concerns
- D. Documentation
- E. Approval of the EAP

APPENDIX VI-D
FORMAT FOR CRITIQUE
OF EAP EXERCISE

NOVEMBER 1998

Report on Functional EAP Exercise
Name of Project
Project Owner
Ferc Project Number
National Inventory of Dams Number

I. Purpose of Exercise

II. Date and Location

III. Design of the Exercise

- A. Brief description of the physical set-up of the exercise and level of "play"
- B. Selection process of participants
- C. Expectations

IV. Exercise Critique

- A. Summary of oral critique comments (debriefing)
- B. Written comments (this should reference copies of participants' comments - refer to Appendix C)
- C. Discuss timeliness of responses during exercise Assessment of Licensee's capability to notify agencies as necessary and of agencies capabilities to execute timely evacuation (this is to include a review of necessary coordination for information, etc. between the licensee and the agencies).

V. Results of Exercise

- A. Lessons learned
- B. Recommendations
 - 1. Improvements to EAP
 - 2. Ways to improve future exercises

VI. Follow Up Actions

- A. Actions to be taken
- B. Plan and Schedule

VII. Summary Page of Key Critique Comments, Lessons Learned, and Recommendations (since this page summarizes the key points, it should indicate the frequency of each critique comment - this summary should be on a separate page of the report)

Appendices

- A. List of Participants
- B. Copy of Narrative and Messages

- C. Copies of Written Critiques
- D. Copies of Other Pertinent Handouts